S RESOURCE GUIDE
to accompany
The Exploring Science Program
GREEN BOOK (5)

by
Peter Beugger
Aldo Bianchini
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Louise Steele

Doubleday Canada Limited
Toronto

Doubleday Australia
Sydney

TEACHER'S RESOURCE GUIDE
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Illustrated by Li-Wen Wang

Contents

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PURPOSES

The two main purposes of the *Teacher's Resource Guide* to accompany *The Exploring Science Program—Green Book (5)* are to:

1. provide you, the teacher, with some background information about the concepts, processes, and topics being developed in each unit.
2. suggest a wide variety of teaching strategies and learning activities for each unit, that complement, extend or reinforce the material presented in the textbook, and give you the resources to design a program that meets the needs of individual students.

FEATURES

The Unit Overview

The Unit Overview consists of the following sections:

Concept Development. The main concepts of the unit are discussed in terms of how they are developed in the unit; how they were introduced and presented in the preceding units, and how the concept relates to child development.

Process Development. This feature describes the processes that are developed in the activities of the unit. It also includes some in-depth discussions of process skills that particularly relate to that unit.

Related Units. All units in the Exploring Science Program that further develop a concept, or that develop related concepts, are listed.

Materials and Advance Planning. Materials needed for a student, or a group of students, to carry out the activities, are listed. In some instances, suggestions are made for advance planning.

Background Information

The purpose of this feature is to provide you with additional information on the topics presented in the text. You may wish, at your discretion, to inject some of this additional information into class discussions.

Teaching Strategies

The Teaching Strategies include:

Suggested activity, discussion, or research. These suggestions are meant to enrich, reinforce, or complement the concepts and processes presented in the text. They are interdisciplinary in nature.

Worksheets. These worksheets may be reproduced for use by individual students. They can be used to review or record material presented in the unit.

Activity Cards. The activity cards may be used in learning centres, or by individual students. They generally pose a question, or make a statement, that allows for further activity, investigation, discussion, or research.

SCOPE AND SEQUENCE CHART

YEAR	LIVING THINGS (Biological Sciences)	MATTER AND ENERGY (Physical Sciences)	THE EARTH AND SPACE (Earth-Space Sciences)
ORANGE BOOK (1)	Your Senses Living Things	Sorting Light and Shadows	Time Spaces and Places
GOLD BOOK (2)	Food for Animals and You Environment	Measuring Magnets	The Moon Rocks and Soil
BLUE BOOK (3)	Seed Plants Animal Behaviour	Heat and Temperature Sounds Around You	Water in Your Environment Location, Motion, and Force
BROWN BOOK (4)	Plant Growth and Behaviour Animals and Their Environment	Work and Machines Solids, Liquids, and Gases	Air and Weather Watching the Sky

GREEN BOOK (5)	Small Living Things Your Body	Electricity on the Move Light	The Changing Land Mapping the Earth
RED BOOK (6)	Interacting with your Environment Plant and Animal Life Cycles	Matter and You Changes in Energy	The Earth in Space Ecosystem Earth
(7)	Ecology: Interaction in the Environment Biology: The Study of Living Things The Human Body: A Study of Yourself	Science: Something People Do Energy: For Work and Motion Technology: Using Science	Earth: Its Nature and Importance to You Weather: The Changing Atmosphere Water: More than a Resource Universe: Exploring Environments in Space

SCHOOL-WIDE PLAN DATE: ____________	BIOLOGICAL	PHYSICAL	EARTH-SPACE
YEAR 1			
YEAR 2			
YEAR 3			
YEAR 4			
YEAR 5			
YEAR 6			
YEAR 7			

SCIENCE PLANNING OUTLINE

TEACHER ______________________ GRADE ______________________

	BIOLOGICAL	PHYSICAL	EARTH-SPACE
SEPTEMBER			
OCTOBER			
NOVEMBER			
DECEMBER			
JANUARY			
FEBRUARY			
MARCH			
APRIL			
MAY			
JUNE			

GREEN BOOK (5)

Unit 1: Small Living Things

Pages 6-47

UNIT OVERVIEW

Concept Development

In the preceding levels of the program, the following concepts were introduced and developed:

There are many kinds of living things. The two broad groups of living things are the plants and animal kingdoms. Some of the characteristics of living things are that they grow and change, they reproduce their kind, they use food for energy, they breathe, they respond to stimuli and they adapt to the environment they inhabit.

In this unit, the students explore some of the simpler forms of life (bacteria, protozoa, algae, fungi, mosses, worms, insects and spiders). The unit develops the concepts that living things have characteristic *structures and functions, behaviour* and *patterns of adaptation* to their environment. Living things are also continually *interacting* with other living things and with the physical environment.

Unit 1 "Small Living Things" consists of three chapters. Chapter one introduces bacteria, protozoans and algae and discusses their effects on people and the environment. The second chapter discusses fungi and mosses, including their similarities and differences, and their importance to people. The structure and functions of worms, insects and spiders are considered in chapter three.

Process Development

In this unit students carry out simple, systematic investigations in order to *observe* and *compare* the structure, functions and needs of some living organisms.

Students begin the unit by *observing* the growth of some bacteria colonies (page 11). Then they *investigate* ways in which bacterial growth can be controlled and stopped (page 13). In both these investigations, it is important to stress caution and the importance of careful clean-up. In the "Finding Out" (page 18) students prepare a culture of protozoa. They *observe* and *compare* the different protozoans. You may wish to have your students use microscopes to observe the protozoa. Molds are grown, *observed* and *compared* (page 25).

The environmental conditions required by earthworms (page 32), ants (page 37) and spiders (page 42) are investigated.

Related Units

Living Things *Orange Book (1)*
Environment *Gold Book (2)*
Seed Plants *Blue Book (3)*
Animal Behaviour *Blue Book (3)*
Plant Growth and Behaviour *Brown Book (4)*
Animals and their Environment *Brown Book (4)*
Plant and Animal Life Cycles Red Book (6)
Biology: The Study of Living Things *Exploring Living Things (7)*

Materials and Advance Planning

The following list includes the materials that a student, or in some cases a group of students, will need to carry out the activities in this unit. In some instances, other materials may be substituted for those on the list.
7 widemouthed, metal jar lids or 7 petri dishes; potato; clear plastic food wrap; pan of water; package of plain gelatin; bouillon cube; sour milk; 3 brands of antiseptics (mouthwashes will do); small mixing bowl; paper towels; jar of distilled water or rain water; dried grass or weeds; cooked rice; hand lens; microscope slides (if available); eyedroppers; 3 jars with screw tops; piece of bread; earthworms; different kinds of soil (clay, sandy soil, humus); pie pan; aluminum foil; widemouthed jar; tall, narrow tin can; flat pan of water; black paper; ants from an anthill; 2 small jars with lids; window screening to cover top of jar; harmless spider; moist cotton.

For the additional activities described in this guide: water from a flower vase; microscope slides; cover slips; clover plant; 5 petri dishes; agar-agar; electric hot plate; pan; tongs; measuring cup; soiled fork; measuring spoons; 1 L of milk; earthenware bowl (1.5 L); thermometer; seedless grapes; plastic coated paper plates; cheesecloth; 1 L jar; dry grass or hay; cooked rice; pond water; orange; blue cheese; rye bread; yeast; milk; 50 mL sugar; 15 mL salt; 50 mL corn oil; 1250 mL whole wheat flour; yeast; three 250 mL jars; 15 mL corn syrup; large bowl; 15 mL sugar; 15 mL corn starch; small bowl; microscope; slides; iodine solution; raw liver; mealworms; bran; 3 small cardboard boxes; 4 wooden pegs; hammer; stopwatch; perfume; metre stick; jar; thermometer; 2 bananas; two 1 L jars; hand lens; 1 funnel; 4 coloured pencils; three 250 mL jars.

You may wish to locate a source of earthworms, ants and spiders before you begin this unit. Agar-agar and mealworms, required in some of the extension activities should be ordered from a biological supply house.

BACKGROUND INFORMATION

Chapter 1: Smaller than a pinpoint, pages 8-22

Bacteria are one-celled microscopic organisms that are rod, round or spiral shaped. A rod-shaped bacterium is called a bacillus, while a round-shaped bacterium is known as a coccus. Spirillum is the name given to a spiral-shaped bacterium.

Some kinds of bacteria are harmful to people. For example, a round-shaped kind of bacterium called a pneumococcus causes a particular kind of pneumonia. Tuberculosis is caused by a rod-shaped kind of bacterium known as a tubercle bacillus.

Many infectious diseases are caused by bacteria. Doctors sometimes determine the kind of infectious disease a person has by determining the kind of bacterium causing the disease. This is usually done by growing a culture of the bacteria. For example, if a person has a sore throat, a doctor might swab the person's throat, picking up some of the bacteria in that area. The bacteria are placed in a substance containing nutrients which enable the bacteria to grow. Then the bacteria are observed through a microscope to determine what kind they are. This information enables a doctor to select the medicine he or she might prescribe to help eliminate the infectious disease.

Even though some bacteria are harmful to people, most bacteria are helpful to people. For example, certain kinds of bacteria in the soil break down dead organic matter into nutrients that can be used by living organisms. Other kinds of bacteria live within nodules on the roots of plants such as clover and beans. These bacteria provide the plants with nitrogen which is an essential element for growth. Other kinds of bacteria normally live in the intestines of people and produce small amounts of essential vitamins.

Another kind of tiny, one-celled living organism is called a protozoan. Like most one-celled organisms, a protozoan has only one nucleus, which carries out all the essential functions of the organism. Because protozoans can move about by themselves, some scientists classify protozoans as animals. However, other scientists hesitate to classify a one-celled organism as an animal because animals are made up of many cells. The solution is that protozoans are usually classified as animal-like organisms.

One kind of protozoan is a paramecium. Parameciums have small hair-like structures around the outer edge of their cell membrane. These structures are called cilia. Parameciums use their cilia to move through water.

Another protozoan is the amoeba. An amoeba has no definite shape. When moving from one place to another, fingerlike projections extend from the amoeba. These fingerlike projections are called pseudopodia, or false feet. As the pseudopodia move outward, the living material within the amoeba flows into the pseudopodia. This movement of the living material causes the shape of the amoeba to change almost constantly.

Another kind of protozoan is called the euglena. The euglena is a one-celled organism. It moves about by means of a single hairlike structure called a flagellum. The flagellum produces a whipping action that moves the euglena through the water.

The euglena, unlike the amoeba and the paramecium, contains chlorophyll. The presence of chlorophyll enables the euglena to make its own food through the process known as photosynthesis. (Photosynthesis is the process whereby the energy from sunlight is used to change carbon dioxide and water into sugars.) However, the euglena also has the necessary parts within its cell to eat as other protozoans do.

Like bacteria, protozoans live in many places. Many protozoans live in water and others can be found living within animals.

Most kinds of protozoans are not harmful. In fact, some protozoans are the main source of food for tiny animals. However, some protozoans are harmful to people because they cause diseases such as malaria and amoebic dysentery.

Besides the bacterium and the protozoan, another kind of tiny living organism is the alga. Some kinds of algae are single celled, and other kinds are multicelled. However, all algae contain chlorophyll, which is essential for these plants to make their own food by means of photosynthesis.

Although all algae contain chlorophyll, they are not all green in colour. Some algae contain certain pigments that cause these algae to be golden brown, brown or red. Other algae do not contain these pigments, so these algae are green.

Green algae are found primarily in fresh water. Diatoms, a type of golden-brown algae, are the major source of food for ocean animals. Brown algae are the seaweeds and kelps often found washed ashore along rocky coasts of the ocean. Red algae are light and delicate and grow at much deeper depths in warmer ocean waters than do other kinds of algae.

Algae are especially important to people. The primary reason algae are of such importance is because during photosynthesis, algae produce oxygen, which people need to survive.

Chapter 2: Matchbox garden, pages 23-28

Fungi make up a large group of plants that vary greatly in size and shape. There are over 75 000 known species of fungi. Fungi include such plants as mushrooms, yeasts, molds, rusts, smuts and puffballs. Although there are many different species of fungi, all fungi have certain things in common. Those things include the absence of chlorophyll, which prevents fungi from making their own food, and the absence of roots, stems and leaves.

Fungi are helpful to people in a number of ways. Yeasts are important to people because they cause

bread dough to rise as they give off carbon dioxide. In addition, certain molds growing in cheeses give the cheeses their distinctive flavour. Another kind of mold known as penicillium became extremely important when it was discovered that penicillium killed many harmful bacteria. In time, penicillium was used to produce the antibiotic penicillin.

Of all the ways in which fungi are helpful to people, the most important is the effect fungi have on dead plants and animals. Because fungi cannot produce their own food, they must live off other organic substances. In the process of living off dead plants and animals, fungi break down these dead organisms. The result of this breaking down is the production of a richer and more fertile soil for the growth of plants.

Although most fungi are helpful to people, some fungi are harmful. For example, athlete's foot and ringworm are caused by fungi. Fungi such as rusts and smuts attack grain crops. Other fungi cause plant diseases such as chestnut-tree blight and Dutch elm disease.

Another group of small plants are the mosses, tiny green plants that grow on land, especially in moist soil. However, mosses are usually able to live through dry spells by becoming dormant. Mosses are considered to be pioneer plants. That is, they will begin to grow in areas that have no other vegetation. The mosses therefore prevent soil erosion and provide additional nutrients for the soil when the plants die.

Chapter 3: Minizoo, pages 29-43

Just as there are many plants in the world, there are also many animals. One very small animal is the flatworm, of which there are three kinds.

One kind of flatworm is the planarian. Planarians are small, ranging in length from several millimetres to several centimetres. They are essentially flat, have brown or black pigmentation, and live in fresh water. Planarians feed on small living or dead organisms.

Planarians are considered to be primitive animals even though they have a nervous system, a digestive system, a reproductive system and an excretory system. Planarians also have two light-sensitive eyespots near the anterior portion of their body.

Planarians move by means of cilia, or hairlike structures, located on their outer edge. These animals capture food by wrapping themselves around a prey, thus entangling the prey in slime and pinning it down.

Some planarians have the ability to regenerate destroyed or severed parts of the body. For this reason planarians have been studied to try to determine what enables them to carry out the process of regeneration. Such studies have been carried out because knowing how regeneration occurs may be of great benefit to people.

Besides the planarians, two other kinds of flatworms are the flukes and the tapeworms. Flukes and tapeworms are parasitic and therefore cannot live without a host. Most flukes and tapeworms live within the intestinal tract of their host. There, the flukes and the tapeworms embed themselves in the host's tissues, absorbing nutrients directly from the partially digested food passing through the intestine.

Another kind of worm is the roundworm. Round worms, as their name implies, have a smooth outside wall and are nonsegmented. These worms are usually two to thirty centimetres in length. They can be found living in seawater, in fresh water or in soil. Some kinds of roundworms are classified as predators, having teeth and mouth parts. Other kinds of roundworms are classified as scavangers, or parasites, and include the pinworm, the hookworm, and the trichina.

Earthworms are a kind of worm known as segmented worms. Earthworms are terrestrial animals and are scavengers that feed on leaves or on other organic matter, living or dead.

Earthworms achieve locomotion with the help of four pairs of slender bristles in each segment. The bristles are inserted into the soil and the body is then pulled forward. Earthworms have a nervous system, an excretory system and a circulatory system. Earthworms are especially beneficial to soil. Their burrowing allows air and water to reach the roots of growing plants. Earthworms also excrete wastes that add nutrients to the soil.

Insects comprise one of the larger animal groups, both in number of species and in number of individuals. Perhaps one of the reasons insects make up such a large group is that they have wings. Wings aid the insects' ability to survive by providing a way of escaping enemies, of finding food and of facilitating mating.

TEACHING STRATEGIES

The purpose of the following activities and teaching strategies is to provide you, the teacher, with a wide variety of suggestions that can be used, together with the material presented in the textbook, to help develop the processes and concepts of this unit.

Chapter 1: Smaller than a pinpoint, pages 8-22

- Pages 8-10 can be read and discussed.
- Since many of the experiments in this chapter will be using the microscope, you may wish to have the students use a coloured file folder to hold their worksheets and activity cards. The title of their folder could be *"Looking into Microworlds"* and an outline of a microscope could be drawn on the cover. These folders could be displayed later in the library. To add more interest, students could take turns performing or setting-up experiments in the library for others to enjoy. This could be a noonhour activity.
- A worksheet for the *"Finding Out"* (page 11) is available in the activity book, page 2.
- Students can examine the presence of bacteria with

the use of a microscope if they use the following activity cards:
Activity Card 1: *Puddles and Ponds*
Activity Card 2: *Fresh Flowers*
Activity Card 3: *Fields of Clover*
Activity Card 4: *Sulphur or Iron Springs*
Activity Card 5: *Bacteria on Hay?*

NOTE: It is important that students dispose of all materials at the end of the experiment by placing them in plastic bags; any liquid should be flushed down a toilet. Their utensils and hands should be washed well with soap and water.

— Because we stress that only clean things should be placed in our mouths — students may be interested in discovering that bacteria are, in fact, present in our mouths. They can use "Activity Card 6, Bacteria in Our Mouths".
— "Activity Card 7, Bacteria and Its Forms" allows students to identify the different types of bacteria (i.e. bacillus, coccus and spirillum).
— Research can be conducted to discover how pickles, cheeses and chocolate acquire their specific flavours. As an extension of their research, students could make sauerkraut (see Teacher's Guide, page 9).
— Students could make yogurt. You may wish to explain that dairies add lactic acid bacteria to the milk to make this product, however if this is not available, the same product can be made with a starter culture. A *yogurt recipe* is available on Activity Card 8.
— The school nurse could visit and explain:
 (1) the purpose of immunization programs
 (2) the various types of vaccines to control viruses or bacteria
 (3) how some of the vaccines are made and how our body reacts to them
 (4) the length of protection
 (5) the immunization required for international travel.
— A veterinarian could be a guest and explain:
 (1) the kinds of viruses that affect pets (e.g. rabies, distemper and parvo virus).
 (2) immunization programs for pets
 (3) different carriers of rabies and what is meant by a "rabid" animal
 (4) immunizations required if transporting an animal across the Canadian/American border.
— Pages 12-14, Why are bacteria important?, can be read and discussed.
— A worksheet for the "Finding Out" on page 13 is available on page 4 of the activity book.
— You may wish to discuss the process used to pasteurize milk. Students can observe the action of bacteria in milk, when they complete "Activity Card 9, Seeing Through Milk: I". This experiment requires "raw" (unpasteurized) milk. Later, a field trip could be made to a local dairy.
— Students can examine sour milk or buttermilk to observe bacteria in each. See Activity Card 10, Seeing Through Milk: II.
— Food preservation:
 (1) A group of students could research the methods used in early times to preserve food. They could present this information to the class.
 (2) "Activity Card 11, Raisins vs. Grapes" is designed to show pupils that fresh grapes will spoil quickly but dried grapes (raisins) will last a considerable time.
 (3) Some pupils may have used dehydrated foods on hikes or camping trips. These questions could be asked:
 (a) What are the advantages of dehydrated foods for campers? (Take less space, less spoilage, can be used any time, allow a more nutritious meal)
 (b) Why can these foods be kept so long without spoiling? (Water has been removed. Therefore, it is less likely that bacteria will develop.)

Dehydrated foods are available from camping supply outlets. Students could prepare dehydrated strawberry shortcake — a gourmet delight for campers!
— Various types of food poisoning could be researched (e.g. botulism, salmonella poisoning)
— You could have pupils suggest some enemies of bacteria. (e.g. soap and water, ultraviolet light, extreme heat or cold, certain chemicals, sterilizers, proper food preparation, etc.)
— Students would enjoy writing a story using the title "A Day in the Life of Joe Bacterium" OR "This Is Your Life — Joe Bacterium!" The content of the story could cover the information given on pages 8 to 14. Joe tells the story. He might include his characteristics, where he lives, why he enjoys life or a problem that he's experiencing and how he's solving it.
— Students can make murals of various food chains similar to the drawing on page 14. They might wish to start with themselves.
— Pages 15 to 19, Protozoans, can be read and discussed.
— A worksheet for the "Finding Out" on page 18 is available in the activity book on page 18.
— After the completion of the "Finding Out" activity which uses rainwater or distilled water, students could do "Activity Card 12, Discovering Protozoans" which uses pond water. They can compare the forms of life found in the different kinds of water. A summary could be made from these studies:
 (1) Can pond water animals live alone?
 (2) Do you think pond water animals can live in the ocean and vice versa?
 (3) Do the animals change as they grow older?
 (4) Can the pond animals live if dirt and plants are removed?
— Pages 20 to 22, Algae, can be read and discussed.

— You may wish to discuss various kinds of algae and their location. Samples could be collected and examined. (Kinds: blue-green, green algae, brown and red)
— Kelp — a form of brown algae — has been found to contain large quantities of minerals. The students could (1) research the kinds of minerals found (2) learn where it is found (3) suggest ways that kelp is helpful to our diet and (4) discover what products have kelp as an ingredient. Some of the students may take kelp tablets.
— If the classroom aquarium has algae present, students can take samples and examine them under the microscope.
— An extension to the aquarium activity would involve a field trip to examine algae on trees. It would be helpful to take along magnifying glasses.

Chapter 2: Matchbox garden, pages 23-28

— A session could be held to discuss the importance of knowing whether a mushroom is edible or not and that any mushroom should be checked by an adult before it is eaten.
— You could pose the question: Do all mushrooms grow in dark environments? (No, the puffball grows in sunlight). A nature walk could be conducted and students could search for mushrooms in a variety of locales.
e.g. mushrooms living on tree stumps
mushrooms that grow in sunlight
mushrooms that grow in shady places
shelf-like brackets that grow on trees.
Also they could be watching for
mushrooms that have no gills
mushrooms with strange and unusual shapes
bright-coloured mushrooms that grow in shady places.
Encourage students to study each variety closely but not to remove them from their natural environment. A student could photograph each type. Interested students may wish to identify each type using research books and classify the pictures according to the categories listed above.
— Students may be familiar with the puffball. If you should discover it on the nature walk, have a student strike it with a stick. They will see dusty spores emerge and be scattered by the wind.
— Some students may be interested in growing mushrooms in the classroom. Directions for growing them can be obtained from the agriculture office in your area.
— The topic of mushrooms could be examined using these headings:
(1) Use of mushrooms in early times
(2) The ways mushrooms can be used
(3) Mushrooms as symbols
(4) The mushroom industry today
(5) Fairy rings — fairy tale or real
(6) Stories that relate to mushrooms.
— Students could bring recipes from home that have mushrooms as an ingredient. Each recipe could be printed within a mushroom shape outline, duplicated, cut out and put into booklets. These could be gifts to parents if they are invited to view the students' work in this unit.
— A worksheet for the "Finding Out" (page 25) is available on page 7 of the activity book.
— In pairs, students can extend the "Finding Out" activity by growing molds on other substances (e.g. tomatoes, lemon soda, coffee, apple juice, moist Swiss cheese, damp leather). They can use "Worksheet 1, Data on Molds" to record their observations.
— Students could think about this statement:
"Among the molds are some of your worst enemies and some of your best friends."
— Students may wish to bring an orange from home that is beginning to spoil. They can examine the mold with a hand lens. Their observations can be recorded on "Worksheet 2, Juicy Sweet Oranges." You could inform students that the green mold on oranges is called Penicillium; there are many kinds of Penicillium mold but one of them is used to make penicillin.
— "Activity Card 13, A Model of Molds at Work" will show students how molds keep the world from being piled high with wastes.
— "Worksheet 3, The Walking Cheese" will show students how a fungus grows and works. This is a penicillium kind of mold.
— Students could sample small pieces of roquefort and feta cheese, and compare their tastes. (1) Do they taste the same or different? Can you suggest why? (2) How would you describe their flavour? (3) Why do you think the roquefort cheese has more blue areas in some parts than others?
— "Activity Card 14, Life in Bread" provides a recipe for making bread. It also requires students to make observations about the bread dough in the various stages and explains the purpose of yeast in bread.
— You can draw to your pupils' attention that yeast plants are not only in yeast packages. They also float in the air. You can have students observe this by leaving a dish of pancake syrup on a shelf. It will get a scum of yeast on its surface.
— Pupils may wish to visit a bakery to watch the process of bread-making.
— You may wish to have your students investigate the yeast fungus in more detail. Activity Card 15, Yeasts on the Move, provides three investigations about yeast.
— Pages 27 and 28, Mosses, can be read and discussed.
— Please see the suggested activity at the bottom of page 27 in the teacher's guide. As an extension to

this trip, students could collect soil and mosses from the area and make terrariums in glass jars on their return to the classroom. You might begin by making a mixture of soil, charcoal and gravel. This will give the terrarium good drainage and allow air to enter the soil. Mosses should be planted so that their roots are not too deep. The amount of moisture should be similar to that of the natural environment.

Chapter 3: Minizoo, pages 29-43

— Pages 29 to 33, Worms, can be read and discussed.
— "Activity Card 16, Searching for Planaria" provides students with instructions for collecting planaria. To extend this activity, students may wish to observe how planarians can regenerate if severed.
— If your school is located near seawater, students could have a night watch, using flashlights to collect sandworms in the sand. After placing these in a jar, they can describe how a sandworm moves.
— A worksheet is available for the "Finding Out" (page 32) in the activity book on page 8.
— "Activity Card 17, Keeping Track of Earthworms" examines the population of earthworms under different climatic conditions.
— Children could make a food chain using worms as a link in the chain.
— Pages 34 to 39, Insects, can be read and discussed.
— Your pupils could collect equal volumes of soil from three different places in a forest. They could compare they types of small creatures found. Are there differences? Why?
— You may wish to have your students investigate the stages in an insect's life cycle, by doing "Activity Card 18, A Mealworm's Meal".
— Several members of the class could collect litter from the forest floor including moss and other material. This litter could be spread in a shallow cardboard box about 2 m x 1 m. Hang a 100 watt bulb over the box's centre about 20 cm above the soil. Sections could be systematically sorted, placing creatures in jars. The little creatures could be classified as insects, worms, others. (In order to classify, pupils will need to know how to identify an insect.)
— Students could collect and identify small creatures found under logs, a patio slab and a sidewalk.
  (1) How many small creatures did you find altogether?
  (2) Under which object did you find the most small creatures? Under which object did you find the fewest small creatures?
  (3) Why do you think one type of object had more creatures under it than another object?
  (4) Suppose many, many creatures lived under one object. What do you think would be the result?

  Students should release these creatures to their original homes and replace the objects gently. Have the students return to the same object and take a count each day. They can graph their findings. Did the numbers of creatures change during the week? Can you suggest why?
— Pupils may wish to observe insects or insect parts under a hand lens or microscope (e.g. fly's compound eye or a butterfly's wing).
— Perhaps you could visit a place that keeps beehives. The owner could explain the design of the hive and show students the queen, drones and workers.
— Films could be shown that demonstrate how bees transfer pollen from one flower to another.
— You could discuss the different kinds of honey produced.
— "Activity Card 19, Ants on Parade" suggests that pupils work in pairs or small groups to investigate ants as social insects. This is an integrated approach to science — experiments, drama, music, making models, panel discussions, ant collections, etc.
— "Activity Card 20, Insect Safari" suggests that students collect live insects for classroom display purposes. The environment where the insect was found should be simulated in the display case. Perhaps a few of your students might wish to give a commentary to interested pupils as they observe the insects. To add to the mood, the commentators could dress up in safari outfits and set up their displays in the hall for other pupils to enjoy.
— Students could research information to understand other insects that live in colonies e.g. ants, termites or wasps. They could collect empty wasp nests and examine them.
— A worksheet is available for the "Finding Out" (page 37). in the acitivty book on page 9.
— If a student discovers any cocoons in the area, students can observe them through the various stages to the butterfly.
— Pages 40 to 44, Spiders, can be read and discussed.
— Students could research to learn about the life cycle of the spider.
— People often have superstitions about spiders. These could be researched and related to the class.
— Students could study how a spider's web is built. Reference books often show their methods. Students could use a branch and try to construct an orb web using thread or yarn. They will realize the talents of a spider! They also may wish to observe the spider at work. Orb-weaver spiders do not begin spinning until nightfall so the student will need a flashlight to watch them. A good example of the orb weavers is the large black and yellow garden spider Aranea gemma.
— Students may wish to collect spiders and to examine their eyes — most have eight — using a hand lens. Appropriate food should be collected for the spiders. Your pupils may wish to observe how the spider eats.

This observation might best be made in the natural environment and then students can see how the captured insect is bound with webbing, its body fluids extracted and the insect released.

— A worksheet is available for the "Finding Out" (page 42) in the acitivity book on page 10.

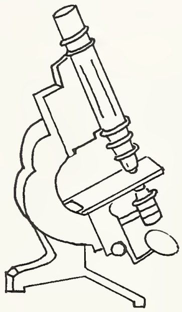
— *Extension Activities:* For further involvement, you may wish to have your students do one or more of the following activities:

1. Winter's coming: Activity Card 21
2. Have tools, will travel: Activity Card 22
3. ... and they're off!: Activity Card 23
4. The fruit fly business: Activity Card 24
5. Snails: Activity Card 25

PUDDLES AND PONDS

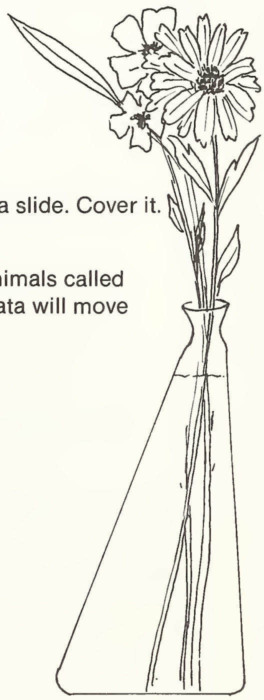
You will need: water from a stagnant pond or puddle
a glass slide and cover slide
a microscope
a jar

- Collect a small amount of stagnant pond water (or water from a puddle) in a small jar.
- Put a drop of the water on a slide. Drop on a cover slide.
- Look carefully at the film of water with your microscope. It may take a few minutes before you notice that the whole background appears to quiver.
  This motion is due to tiny suspended particles — some of them bacteria — which are being knocked around by the constantly moving molecules of water.
- Draw what you see in the space provided below.



Small Living Things, Activity Card 1

FRESH FLOWERS



You will need: water in which flowers have been standing a few days
a glass slide and cover
a microscope

- Place a small amount of water and scum from the stems of the flowers on a slide. Cover it.
- Place your slide under the microscope.
- You will see various objects in your slide. The larger moving objects are animals called ciliata and are much larger than the bacteria that you are seeking. The ciliata will move much faster too.
- Draw what you see in the space below.

Small Living Things, Activity Card 2

FIELDS OF CLOVER

You will need: a trowel or small shovel
a clover plant (white, red or sweet clover)
distilled water and container
a slide
a needle
a microscope with a high power lens

- Dig up one of the clover plants mentioned above. Try to include the soil around the plant.
- Dunk the plant up and down carefully in a container to remove the soil. Notice the little lumps on the roots. These are called nodules.
- Remove a large nodule and place it on the slide. Crush it with a needle and spread the nodule over the slide. Add a drop of distilled water.
- View your slide using the highest power lens that you have. Your slide will look grainy like sand because of the millions of bacteria present in a single nodule.

  It will be difficult for you to single out any one organism but they are sometimes shaped like a rod, sometimes like a club and sometimes y-shaped. These nitrogen-fixing bacteria take nitrogen gas from the air and combine it with water to create a compound. Plants can use it in order to grow.
- We need nitrogen in our foods to produce new tissue in our bodies and to repair the old worn-out tissue. Farmers plant clover in their fields. These nodules fertilize the soil.

Small Living Things, Activity Card 3

SULPHUR OR IRON SPRINGS

Needed: white scum near a sulphur spring
glass slides and cover
microscope

- Place some scum on a slide. Cover.
- Place under microscope. You will find long filaments filled with tiny granules. This is sulphur which bacteria produce from hydrogen sulphide gas dissolved in spring water. It is this gas that gives water an odour of rotten eggs.

Needed: rusty, fluffy masses that float in iron springs
glass slides and cover
microscope.

- Place a bit of rusty mass on slide.
- Cover it. Place it under the microscope.
- Hopefully you will see large rods and some spiral-shaped bacteria called spirilla.

  Bacteria live on the dissolved iron salts of the spring and they spit out tiny bits of metallic iron. Some of Canada's iron deposits may have been made by these bacteria!

Small Living Things, Activity Card 4

BACTERIA ON HAY???

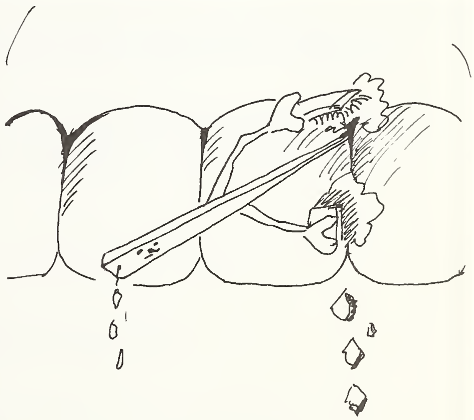
You will need: a handful of dry hay
water
a jar
a glass slide and cover
a microscope

- Place the hay in a jar of water for a few days.
- On the third day, place a drop of the water on a microscope slide and cover it. Place it under the microscope. You should see large bacilli called hay bacillus. These bacteria are harmless.
- Draw what you see in the box below.

Small Living Things, Activity Card 5

BACTERIA IN OUR MOUTHS!!!

You will need: a toothpick
water
a microscope slide
a microscope



- Place a drop of water on your slide.
- With a toothpick scrape your teeth near your gums. Rub the end of your toothpick around in the water. Place the slide under the microscope.
- Look at the slide for a few minutes. You may have to adjust the light to accustom your eyes to the field.

You will notice that the slide has a collection of clumps. These clumps are particles of foods.

If you look carefully you should find some flat, irregularly shaped plates. Those are cells from your gums.

Can you see tiny rod-shaped objects in the spaces between the larger pieces. They are the bacteria!!

- Draw a picture of what you see on your slide.

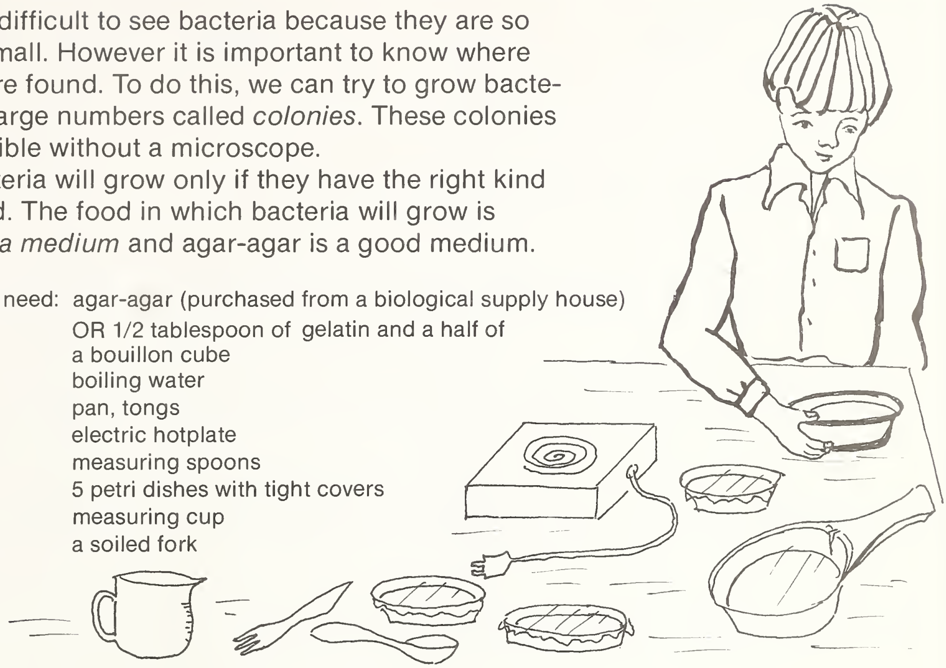
Small Living Things, Activity Card 6

BACTERIA AND ITS FORMS

It is difficult to see bacteria because they are so very small. However it is important to know where they are found. To do this, we can try to grow bacteria in large numbers called *colonies*. These colonies are visible without a microscope.

Bacteria will grow only if they have the right kind of food. The food in which bacteria will grow is called *a medium* and agar-agar is a good medium.

You will need: agar-agar (purchased from a biological supply house)
OR 1/2 tablespoon of gelatin and a half of a bouillon cube
boiling water
pan, tongs
electric hotplate
measuring spoons
5 petri dishes with tight covers
measuring cup
a soiled fork



- First you must sterilize your equipment. The cup, petri dishes and their covers as well as the spoons should be sterilized by boiling them for fifteen minutes. (Do not include soiled fork.)

- In the meantime, bring 125 mL of water to a boil. Stir in 5 mL of powdered agar-agar and boil this mixture for five minutes. (If you cannot obtain agar-agar, use 10 mL gelatin and add one half bouillon cube to 125 mL of water, and boil). Remove the boiled utensils with the tongs. Place them on paper towels.

- Pour a thin layer of the agar-agar mixture in each of the petri dishes. This liquid will harden as it cools. Label the covers: #1, #2, #3, #4 and #5.

- Now you can contaminate the sterile medium in several different ways:
  Dish #1 — Roll a pencil over this dish. Cover.
  Dish #2 — Rub a dirty finger over this dish. Cover.
  Dish #3 — Wash the finger that you used for Dish #2 with soap and water. Now roll it over dish #3. Cover the dish.
  Dish #4 — Roll a soiled fork over this dish. Cover.
  Dish #5 — Leave this dish untouched as a control. Cover it quickly.
- Place your dishes in a warm — not hot — place for two days. At the end of this period, several white spots should be visible. These spots are colonies of bacteria. Make a chart to show your findings. Also include drawings of your petri dishes and show where the bacteria appeared.
- Try the same experiment again, except place the dishes in a *cold* place this time. What happened?
- You can record all your findings on the next page or make your own charts and diagrams into a booklet.

Small Living Things, Activity Card 7

BACTERIA AND ITS FORMS (continued)

DISH	WARM	COLD
1		
2		
3		
4		
5		

Small Living Things, Activity Card 7 (continued)

A Recipe for YOGURT

In this recipe, you are using a yogurt culture to convert milk into yogurt.

You will need: one litre of milk
culture: 75 mL plain yogurt (try to use a brand without additives)
saucepan
earthenware dish
measuring spoon and large stirring spoon
earthenware bowl (1.5 L size)
thermometer

- Heat the milk in the saucepan to approximately 43° C.
- Pour the warm milk into your bowl.
- Cool the milk. It should feel warm but not hot when you put a drop of it on the inside part of your wrist.
- Add the yogurt to the milk. This yogurt should be at room temperature.
- Blend the two ingredients gently.
- Cover your bowl and then wrap the bowl in a warm blanket. Let it stand for at least five hours or overnight at room temperature. Do not refrigerate.
- Then place bowl in refrigerator. The yogurt will be ready to taste the next day. When ready to serve, cut up fruits could be added to the yogurt.

Small Living Things, Activity Card 8

SEEING THROUGH MILK I

You will need: four 250 mL jars with lids
pasteurized milk
raw milk (unpasteurized milk)
boiling water

Experiment #1

- Fill 2 jars with boiling water and set them aside for 10 minutes to sterilize them.
- Fill one jar with pasteurized milk and the other with raw milk. Cover both jars tightly to prevent contamination by bacteria in the air.
- Leave them in a warm place for several days.
- Was it the raw milk or the pasteurized milk which went sour first?

Experiment #2

- Fill two glass jars with raw milk.
- Cover them tightly.
- Place one in the refrigerator and leave the other one in a warm place.
- Which jar of milk soured first?
- Does this show us how to keep bacteria from growing? Explain.

Small Living Things, Activity Card 9

SEEING THROUGH MILK II

You will need: buttermilk or sour pasteurized milk
water and bowl
a microscope
a microscope slide

- Place a tiny drop of buttermilk or sour milk on your slide.
- Mix a drop or two of water with the milk so that you can see through it.
- Place the slide under the microscope. Look at the clear spaces between the clumps that you see.

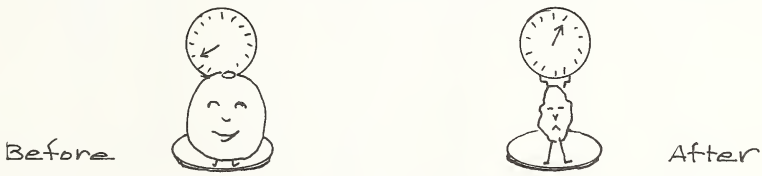
  It may be necessary to focus your microscope very slowly up and down through a small range. Lighting is very important. Adjust the mirror in different positions. To get a better light you may have to turn the mirror away from the stage and use a light from above or from the side.
- Can you see the bacteria moving? Show your findings in a drawing.

Small Living Things, Activity Card 10

RAISINS VS. GRAPES

You will need: 10 ripe, firm seedless Thompson grapes
a scale
pan of water
towel
plastic coated paper plates
clean cheesecloth (sufficient quantity to cover paper plates)

- Wash the grapes in the water. Pat them dry with a towel.
- Set aside 5 grapes on a paper plate. Leave this plateful uncovered.
- Place the rest of the grapes on the paper plates so that there is only one layer of grapes on each. Weigh these plates. Record their weight in your book.
- Place the cheesecloth over the grapes and secure it so that it cannot blow off.
- Place the plates on blocks so that air can circulate around the plates.
- Put your plates in direct sunlight to dry. Leave them for about 4 days.
- Test them for dryness by squeezing them in your hand. If the grapes spring apart when you open your hand, the grapes are dry enough. You will find that they are pliable and leathery. If they are not dry, test them again the next day.
- Whenever your grapes are dry, weigh them on the plates. Record their weight.



- Compare the weights of the fresh grapes and the raisins. How much moisture was lost?

- What has happened to the fresh grapes?

- How long do you think you could keep raisins in a jar?

If you guessed about six months, you were right!

Small Living Things, Activity Card 11

DATA ON MOLDS

Name: ____________________

Kind of Specimen: ____________________

Week of ____________________

DAY OF WEEK	COLOUR	OBSERVATION	
		DESCRIPTION	DRAWING
MONDAY			
TUESDAY			
WEDNESDAY			
THURSDAY			
FRIDAY			
WEEKEND PREDICTION			

DISCOVERING PROTOZOANS

The protozoa are one-celled animals. They are one of the smallest forms of animal life and therefore it is easier to look at them if you use a microscope. You can raise your own protozoa culture if you follow these directions!

You will need: a 1 L jar
hay or dry grass
cooked rice
water from a pond or stream

a microscope
a microscope slide and cover
a narrow glass tube or a straw

- Go to a pond or stream. Collect a litre of the water and also collect some of the water plants and mud of the same area.
- Protozoa need nourishment and they will grow and reproduce rapidly on the proper diet. Add a little hay or dried grass and a few grains of cooked rice to the culture.
- Place your jar (uncovered) in a warm, dark place for several days.
- Look for a rice grain on the bottom of the jar. Using the glass tube or a straw, suck up a drop of the culture from close to this rice grain.
- Place the drop on your clean microscope slide. Cover it.
- You should be able to see several kinds of protozoa as well as algae, bacteria, flatworms and roundworms.
- How many can you identify?

Small Living Things, Activity Card 12

JUICY SWEET ORANGES

Record the dates beside the data below:

(a) When I put spores on my orange ____________________

(b) When I first saw a white spot ____________________

(c) When I first saw some green spores ____________________

(d) When half of the orange was covered with mold ____________________

(e) When the whole orange was covered with mold ____________________

How many days had elapsed when you found your orange covered in mold? ____________________

Small Living Things, Worksheet 2

A MODEL OF MOLDS-AT-WORK

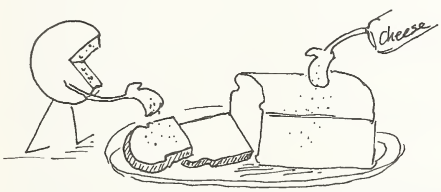
This model of molds at work will show you how molds keep the world from being piled high with wastes!

You will need: a large glass jar with lid
soil
small pieces of bread, paper, orange peel, twigs and grass

- Fill your jar about half full of soil. Add half of the bread, paper, orange peel, twigs and grass to the soil. Mix it.
- Place the rest of the bread, etcetera on top of the soil in your glass jar.
- Sprinkle the wastes so that all is damp but not very wet. Don't cover the jar too tightly, because some air must get into the jar.
- Sprinkle the waste with water every few days. Now your model will begin to work.

Watch it for a long time. Soon molds will begin to grow and the wastes will get soft and rot. Your model will work until all the wastes have rotted and most of it will become part of the soil! Have fun watching this model-at-work!!

Small Living Things, Activity Card 13



"THE WALKING CHEESE"

You will need: blue cheese
a piece of rye bread
a few drops of milk
a magnifying glass

If you want to watch a fungus grow and work . . .

- Scrape a little of the vein of blue cheese onto a piece of rye bread.
- Add just a few drops of milk.
- Place the bread in a dark place for about ten days. In that time, the fungus will cover the bread!
- With a magnifying glass you can watch its growth. What happened each day?

Small Living Things, Worksheet 3

LIFE IN BREAD

Preheat oven to 190° C.

1 package of yeast 125 mL luke warm water	Place these ingredients in a mixing bowl. Mix well and let stand for 5 minutes.
250 mL milk 125 mL boiling water 50 mL sugar 15 mL salt 50 mL corn oil	Mix these ingredients in another bowl. Mix well. Cool this mixture until lukewarm.

- Add the yeast mixture to the milk mixture.

- Add 1250 mL of whole wheat flour to the combined mixtures. Mix and beat well using a wooden spoon. When your dough becomes stiff, mix it with your hands. It may also become sticky. If so, add a little more flour.

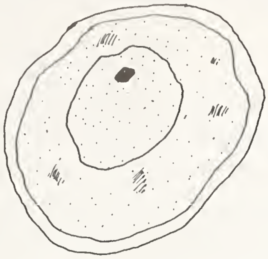
- Knead your dough on a floured board until it becomes smooth and elastic. This will take about 8-10 minutes.
- Oil a large mixing bowl. Place your dough in it. Wipe oil over the surface of your dough and cover with a clean towel.
- Put your bowl in a warm place and let the dough rise until it is double in size. This may take about an hour.
- Your bread is ready now to shape into loaves or rolls. Maybe you would like to make designs on your dough.
- Place your dough in an oiled baking pan. Again put it in a warm place and cover it with a towel.
- Let it rise until double in bulk. This may take about 50 minutes.
- Place in the oven. Bake rolls for 20 to 30 minutes or bake loaves about 50 minutes at 190° C.
- When your bread is done, remove it from the pans and cool it on a wire rack.
- As your bread bakes, think about these questions and record your answers:
  1. How did the bread dough react before it was baked?
  2. Did the dough change shape while baking?
  3. What did it smell like before it was baked?

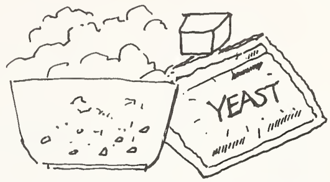
Did the bread smell the same after it was baked? Explain.

> Your bread really did have 'life' in it! The yeast that you added is a substance that bakers put in dough to make it rise. This yeast contains a mass of tiny one-celled plants called yeasts. Enzymes from the yeast cells attack the starch in the flour and change it to sugar. The sugar is then changed to alcohol and carbon dioxide gas. The gas bubbles up through the mixture, forming bubbles in your dough. This makes your bread light in texture when baked. When the bread is baked, the alcohol evaporates and yeast plants are destroyed. If your bread is baked properly, your bread should not taste of alcohol or yeast.

Small Living Things, Activity Card 14

YEASTS ON THE MOVE





Yeasts are little one-celled plants which reproduce by "budding". There are hundreds of species of yeasts, but the most common is the yeast cake that we purchase in a grocery store. This yeast cake is the type used to make bread. It is the gas, produced by the growing yeasts, that puffs up the dough and let's you enjoy bread more.

Yeast has been used for centuries. One of the tombs at Thebes contained loaves of bread which had been left as an offering for the dead. Scientists identified yeast cells in this bread. The date of the Theban tomb was 2000 BC!

Yeasts get their food for growth from sugar. They attack the sugar by giving out enzymes, or a ferment. The process is called *fermentation*. Yeasts are found in the air all the time. These yeast cells drop into food and begin the fermentation process.

In this activity you will:

(a) produce some yeast action
(b) observe the cells under a microscope and observe budding taking place
(c) design experiments to obtain yeast action.

EXPERIMENT #1

Purpose: To produce yeast action

You will need: 1 package of yeast
three 250 mL jars
15 mL corn syrup
Large bowl

125 mL warm water (not hot)
15 mL sugar
15 mL corn starch
Small bowl

- Mix yeast and warm water together in a small bowl.
- Evenly divide the above mixture into the three jars.
- Label jars #1, #2 and #3 To jar #1 — add sugar
  #2 — add corn syrup
  #3 — add cornstarch
- Mix each jar's contents well. Set all three jars in a bowl of warm water. In time you will see yeast activity (fermentation) as carbon dioxide forms on the surface. How much foam and the rate of its production tells you which "food" the yeasts like best.
- Smell each jar. You can smell another yeast product — alcohol.

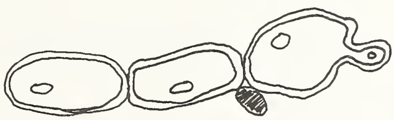
EXPERIMENT #2

Purpose: To observe yeast cells under a microscope and to see how they "bud".

You will need: 1 microscope slide
microscope
1 drop of iodine solution
yeast mixture (from Experiment #1)

- Place a drop of yeast mixture on a slide.
- Put a drop of iodine solution on top of the yeast mixture.
- Place slide under microscope and adjust the mirror to reduce the amount of light.
- Look for yeast cells in several stages of growth. You may see any of the cells in the diagram.

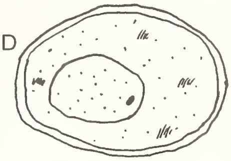
A cell may have more than one bud. Sometimes the cells stick together for awhile and remain in long irregular chains. Eventually, all the new cells will break loose and continue to form buds and new cells of their own. As long as food is present, yeasts will continue to multiply.



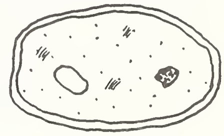
A CHAIN OF YEAST SPORES

- Show what you observed under the microscope. Try to label your drawings to show 'budding'.

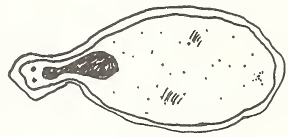
YEAST CELLS HIGHLY MAGNIFIED



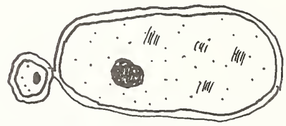
YEAST CELL SHOWING VACUOLE



NUCLEUS FORMED



BUDDING BEGINNING



DIVISION COMPLETE; "MOTHER" AND "DAUGHTER" CELL SEPARATE.

EXPERIMENT #3

Purpose: To design your own experiments to obtain yeast action.

To produce fermenting apple juice!

To make home made sauerkraut! (not canned type)

To produce dill pickle scum!

You read at the beginning that yeasts are in the air. This is something for you to keep in mind when you try to produce ONE of the above. (For sauerkraut, you may have to research how sauerkraut is made.)

Design your own experiment — write the directions step-by-step so that someone else can try your experiment.

Helpful hints: What will you need?
How will you do it?
What could you examine *after* you have produced fermenting apple juice, homemade sauerkraut or dill pickle scum?
Have fun!!!! Experiments can really expand your thinking!

Small Living Things, Activity Card 15 (continued)

SEARCHING FOR PLANARIA

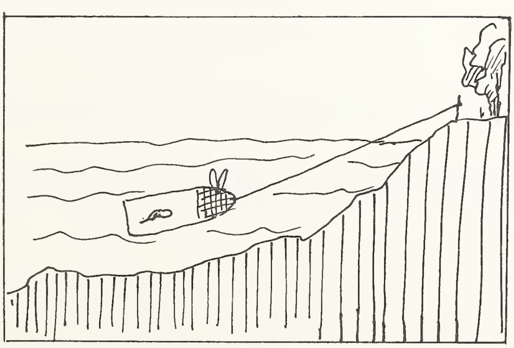
You will need: large jar and string
wire screen with tiny mesh
raw liver
shallow dish

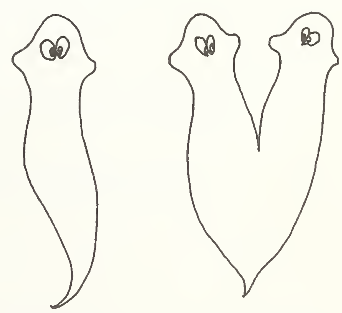
- To collect the planaria, put a piece of raw liver in the glass jar.
- Cover the mouth of the bottle with the screen. Tie the screen with string.
- Tie another chord around the bottle and lower it into a stream. The other end of the string may be fastened to a stake driven in the ground on the stream bank. Leave the jar for about an hour.
- Retrieve the jar, remove the liver and shake off or manually remove any worms on the meat. Transfer the planaria to a shallow dish of stream water for their future home.
- They will need food. Pieces of earthworms, fresh beef liver or the yolk of a hard-boiled egg offer suitable foods for planaria. After the food has been added to their culture, allow 1½ hours for them to feed. Then remove the planaria to a clean container of pond water.
- Observe your planaria. Draw their shape.

To Regenerate Planaria

If you carefully slice the head of a planarian, you may be able to grow a two-headed planarian.

- For best results, use the brown or white planarian available from biological supply companies.
- Allow the worm to stretch out on a piece of glass or on the flat side of a cork stopper. Use a razor blade to make an incision directly behind the head. You may discover that the further back the incision is made from the head region, the less frequently the regenerated worm forms a complete head.
- After cutting the worm, place it in fresh pond water and store it in a cool shaded place. Do not feed while regeneration is taking place.

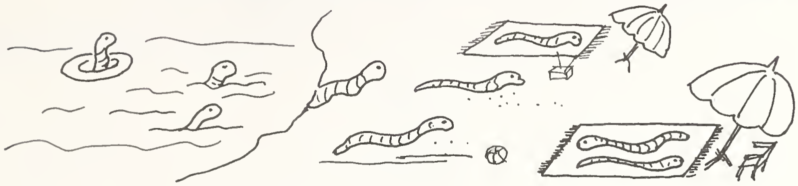




PLANARIAN REGENERATED PLANARIAN

Small Living Things, Activity Card 16

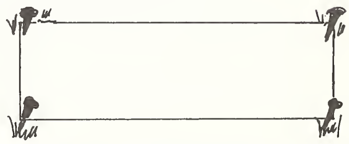
KEEPING TRACK OF EARTHWORMS



You will need: 4 wooden pegs, each about 30 cm long
a hammer
a ball of string or chord

- In this activity, you will be looking for earthworms. You will visit the same area on your school grounds each time but
  — one visit will be on a sunny day
  — a second visit will be on a dull day
  — a third visit will be on a full day of rain
  — a fourth visit will be on a day with light showers

  In other words, you will visit the same area each time but under different climatic conditions.



- It is your task to find which climatic conditions bring the most earthworms to the surface.
- Go to a special area on your school grounds today. Mark an area with wooden stakes. Place string around this area.
- Count the worms that are on the surface of the ground within this area. Record the number of worms found.

Visit	Climatic Conditions	Number of Worms Found
First		
Second		
Third		
Fourth		

- Were there more worms on the ground on a sunny day than a dull day?

- Were there more worms on the ground after a full day of rain or after light showers?

Which type of climatic condition seems to bring the most worms to the surface?

A Mealworm's Meal

Mealworms have four stages to their life cycle:

eggs
larvae
pupae
beetles

The larvae of the mealworm can be stored for some time in this mixture:

— shredded newspaper
— bran
— half a potato or apple
— a crust of bread.

Place your mealworm larvae in this mixture in a container and store it in mild refrigeration.

You will see the larvae change to the pupae stage and then to the beetle stage. The larvae and adult mealworms provide excellent food for snakes, lizards, birds, frogs and other organisms. You might find that these prefer the larvae to the adults!

The larvae are very hardy and allow you to conduct many experiments. Here are a few for you to try:

Try to teach the larvae to run a maze.

Are mealworms more active when warm or cold?

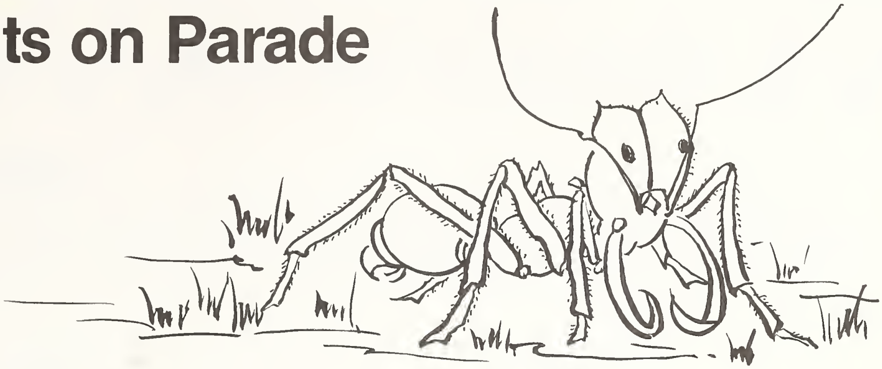
Do mealworms like light or darkness best?

What do mealworms do when near a predator?

Take daily counts of these organisms as they develop in a container.

What other foods do they eat besides bran?

Ants on Parade



Ants are called *social insects* because they live and work in groups. In the ant colony, each one has a job to do.

Here's an opportunity for you to be a social person — to work with others in your class. To be extremely accurate on some of these topics, you may wish to get information and ideas from reference books. Check with your librarian too.

Choose ONE of the following activities:

#1 

SWIMMING ANTS: Scientists claim that ants cannot swim. They suggest that if you put ants in an uncovered dish and set the dish in a pan of water — they won't swim away! Verify whether it is true or not. Show the class. Have the class guess the results before you do these experiments. Do you think that ants could escape if you greased the rim of the dish?

#2 

CARPENTER ANTS: With a friend, try to find a piece of wood that carpenter ants have attacked. Explain to the class (1) how to identify them (2) their life cycle (3) how they attack wood and the results. Try to collect live carpenter ants so that the class will see for themselves. Your ants should be fed too. Release them when you have completed your presentation.

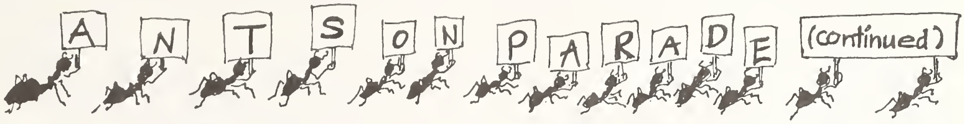
#3 

AN ANT'S LIFE: Work with two other friends. Develop a skit to explain the various roles of ants in an ant colony. For example: the queen, a soldier, a nurse and a male ant.
Question: How can you dress to look like an ant? Have fun!

#4 

ARMY ANTS: With three friends, make up a song telling about army ants. You can use the music of a song that you already know. Try to include in your song information about their life cycle, their roles and/or their everyday life. Add a little show 'biz' to your presentation — dress up, provide actions, sing out! (You will never be forgotten!)

Small Living Things, Activity Card 19



#5

ANT COLONY: Make a side-view model of an ant colony — entrance, tunnels and rooms (nursery, seed storage etc.). You could make this out of a thick piece of styrofoam. A reference book about ants may give you some ideas. Could you place some ants in your model? Work with a friend.

#6

ANTS: HELPERS OR PESTS With a friend, form a panel to disucss this topic. One person should think of ants as helpers, and the other person think of them as pests. Present your view to the class and then let the class vote at the end. Better get some facts to convince your audience!

#7

MARRIAGE FLIGHT: Find out about this event. Inform the class about this event and how a nest is established. Try to collect ant eggs, small white larvae, pupae and adults. Display each in jars — be sure to include some of the objects found in their environment and to provide food for the adults. Let your classmates examine the jars and their contents after you have given your presentation. Work with another person on this activity.

#8

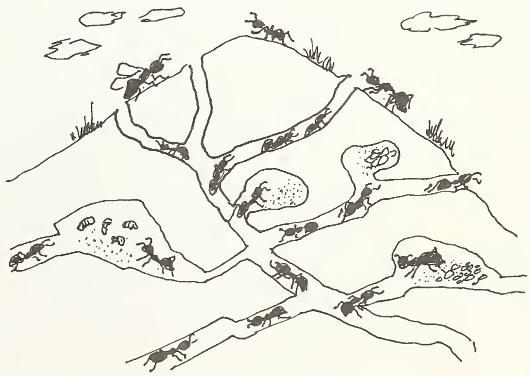
THE QUEEN: Collect queens with their wings attached and without wings attached. Also collect males. Place these ants in separate jars. Explain to the class (1) how you can identify each sex and (2) the life cycle of each. Allow your classmates to examine these ants.

#9

DRIVER ANTS: You are a television newscaster. Create and tell a news story about an attack by driver ants of Africa. Make a diagram, for an overhead projector, showing the attack. Refer to the diagram as you speak to your television audience. Be dramatic — this is a catastrophe!

#10

CARPENTER ANTS: Form a panel of 3 members. Your community has become overpopulated with these ants. It is your task to explain to the class:
(1) how to identify them
(2) the life cycle of the ant
(3) their destructive habits
(4) how to eradicate these ants.
You may be asked some questions. Will you be prepared?



Small Living Things, Activity Card 19 (continued)

AN INSECT SAFARI

You are about to go on a safari — deep into Insect Land!

You and three other friends need to plan an itinerary. Each person should go to a different area so that your group can collect as wide a variety of insects as possible. For example, try damp areas, dry areas and swampy areas.

You might also spot some flying insects. They are usually found on still, sunny days.

Butterflies, millipedes, beetles and ants are but a few that you might find on your safari.

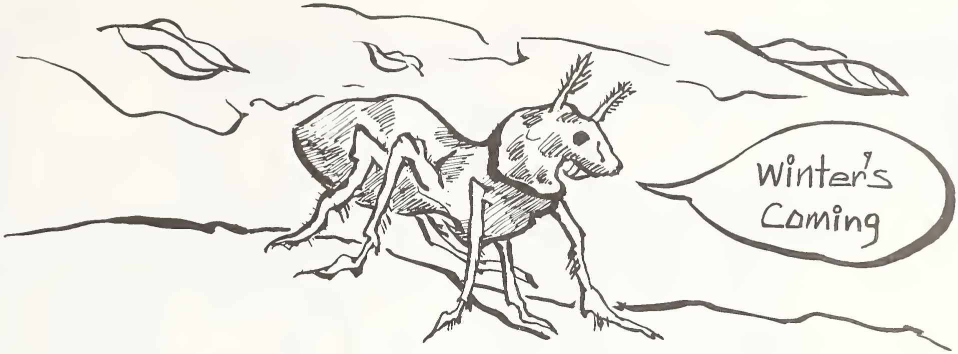
Take along two jars with perforated lids, a trowel and a net. Besides collecting insects, also collect a bit of the environment where the insect was found (i.e. moss, soil, twigs, leaves, stones).

When your group has collected a variety of insects, place the soil and/or other material in a large jar. Just to be different — place your jar on its side with the soil, twigs, and insects in it! Cover the jar's opening with the punctured lid or cover it with gauze.

WATCH YOUR INSECTS DISCOVER THEIR NEW ENVIRONMENT!

What did you learn about your insects?

Small Living Things, Activity Card 20



All summer we hear and see insects. Have a picnic and your extra guests may be flies, ants and wasps. Sleeping under the stars brings the hum of mosquitoes to make you more wide awake!

When cold weather arrives, these insects seem to disappear from the environment. In order to maintain a balance of their own species, they must prepare wisely for winter. Otherwise, their existence will be in danger.

Discover the hardiness of these insects. You may get some surprises! Life in the insect world is different. Try to find out how these insects prepare for a long, cold winter!

flies	cicadas	grasshoppers
mosquitoes	crickets	praying mantis
ants	butterflies	honeybees
wasps	ladybugs	

In summer, where do they normally live?

How do they survive the extreme cold?

Where do they go in winter?

Do they eat? If so, what?

MAKE A BOOKLET CONTAINING THIS INFORMATION
Why not include a cartoon
for each one?
What unique title
could you use for your booklet?

Small Living Things, Activity Card 21

Have you ever forgotten where you have left a hammer or a shovel? It happens to many people but it never happens to many insects. They have their tools with them all the time. Their tools are part of their body structure and are used whenever necessary in their particular ecosystem.

What jobs get done while using these tools?

BEES — have combs and brushes on their legs.

PRAYING MANTIS — spiny legs open and close like a jacknife.

TERMITES — have powerful jaws.

BEES — have baskets.

CENTIPEDES — use fangs.

TEREDOS — have several rows of fine teeth on their shells.

DIVING BEETLES — have a little airpocket.

BURROWING BEETLES — have shovels on the end of the snout.

WATER STRIDERS — have water boots.

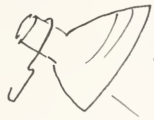
CRICKETS — rub their wings together.

FLIES — have suction pads and hooks on feet.

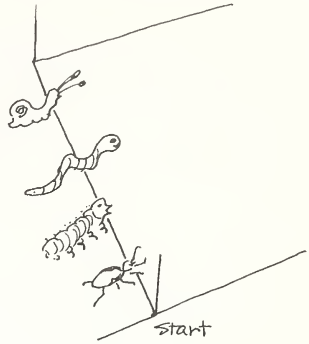
MILLIPEDES — use stink glands.

Try to find some of the above creatures. You can watch them in their natural environment or bring them into the classroom and place them in jars. Having them in a jar lets you get very close to them and watch them at work!

Small Living Things, Activity Card 22



änd they're öff!

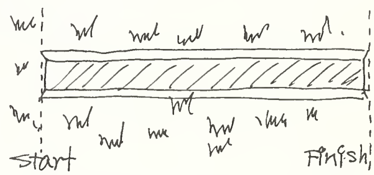


Sound like a horse race? Well this activity card IS about a race, but a beetle, caterpillar, worm, snail or centipede can enter this race. In this activity you will discover how fast an insect or animal can travel. There are four sections in this activity. Work with two other friends.

You will need:

a metric ruler	a jar
a stopwatch	a thermometer
perfume	some type of food
a stick	a beetle, caterpillar, worm, snail or centipede

THE RACE: LAP ONE



- Make a small groove in the ground about 30 cm long.
- Mark a starting point and finish line.
- Time how long it takes one of the creatures to follow the groove to the finish line. If it strays, gently touch it to redirect it into the groove. Test it a few times to get its *average* speed.

ANIMAL/INSECT	TIME				
	Try #1	Try #2	Try #3	Try #4	Average Time

LAP TWO

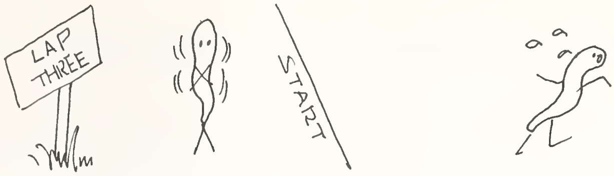
- Try using a variety of factors to make each racer go faster (e.g. sun, shade, perfume, loud noise or food at the end of the line).
- Record your findings in a chart form.

ANIMAL/INSECT	TIME			
	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4

- Which factor was most successful?

- Why do you think this factor provided an incentive to move faster?

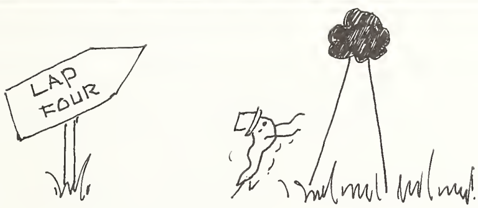
Small Living Things, Activity Card 23



LAP 3

- Take one of your creatures and use it to determine whether temperature controls its speed.
- Place your creature in a jar, in a refrigerator to cool it. Record the temperature and length of time that it was cooled.

  Temperature: ___________ Time: ___________
- How fast did this creature move in Experiment A (average time)? ___________
- Time it on your track after it has been cooled. Did its speed change? ___________ In what way? ____________________
- Do you notice any other differences in its behaviour?
- How does this experiment relate to temperature in this creature's environment?



LAP 4

- Test to see if one of your creatures goes up a tree at a different speed than it goes down. What did you discover?
- How will rates of movement be an advantage to these creatures in their own habitat?
- A disadvantage?
- What animal or other insect might take advantage of these rates of movement? Explain.
- How would the factor of noise affect these creatures lives?

Small Living Things, Activity Card 23 (continued)

THE FRUIT FLY BUSINESS

This is one time that you will accept fruit flies! Normally we think that they are a nuisance. In this experiment you will be raising them. You will be the scientist in the laboratory.

A commercial firm wants to raise a large number of fruit flies in the quickest way possible. They have come to you to find out how they can accomplish this task. There is very little research on fruit flies. You do know that their life cycle is about two weeks. It occurs to you that light and temperature may be factors in raising fruit flies quickly. You decide to run experiments to prove your theory.

First, you must obtain some fruit flies! Since the commercial firm in anxious to get this information, you feel that you should employ five other scientists. Three of you can perform Experiment A and the other three can do Experiment B.

EXPERIMENT A: To use temperature as a factor in growing fruit flies.

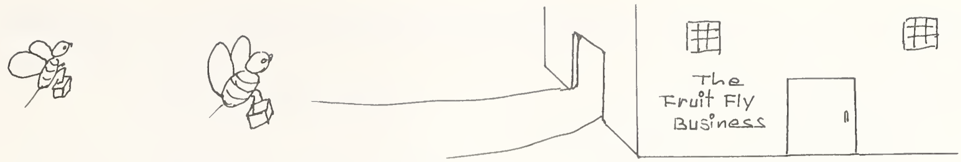
You will need:
- 2 bananas
- 2 jars (Approx. 1 L each)
- 1 hand lens
- 1 funnel
- 3 jars (approx. 250 mL)
- 4 Pencils: black, blue, red and green

- Cut a peeled banana into three pieces. Place the pieces in a jar and fit the funnel into the neck of the jar. Let's call this jar a "fly trap".
- Place your fly trap outside (e.g. in an open area, on an outside window ledge). Leave it for a couple of hours. Check later to see how many fruit flies are in the jar. If you have 15-20, take your jar into the classroom. If not, leave it longer or try a new location.
- Cut your second banana, unpeeled, into three pieces and place it in a second jar. Transfer the flies to this jar. In the classroom, observe the pieces of banana with a hand lens for a few days. Do you see some tiny white specks on the skins? They are fruit fly eggs!
- You will not need the adults now so you can let them free, outdoors.
- Transfer each section of banana with eggs to separate jars and cover. Label.

Jar #1 — Place this jar at room temperature (i.e. away from heat source or a drafty area. This jar is called a "control jar". It represents normal conditions.

Jar #2 — Place this jar so that the temperature of the jar is 32° C to 38° C. You may need to focus an electric light on the jar to maintain this temperature.

Jar #3 — Place this jar in a container with ice cubes around the jar. The temperature should be about 3° C.



- Examine each jar every day and keep a record of any changes on the banana skins and the jar. The fruit fly has four stages in its life cycle: eggs, larva, pupa and adult.

Colour Code your information: Jar #1 — blue pencil
Jar #2 — red pencil
Jar #3 — green pencil

TEMPERATURE																
STAGE	DAY															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
EGGS																
LARVA																
PUPA																
ADULT																

DIAGRAMS OF EACH STAGE			
EGG	LARVA	PUPA	ADULT

STAGE	JAR #1	JAR #2	JAR #3
NO. OF DAYS IN EGG STAGE			
NO. OF DAYS IN LARVA STAGE			
NO. OF DAYS IN PUPA STAGE			
NO. OF DAYS FROM EGG TO ADULT STAGE			

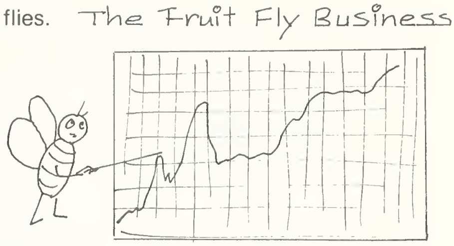
- Is there a difference in the length of the life cycle using different temperatures? If so, in what way?

- What conclusion can you make about raising fruit flies under different temperatures?

EXPERIMENT B follows.

Small Living Things, Activity Card 24 (continued)

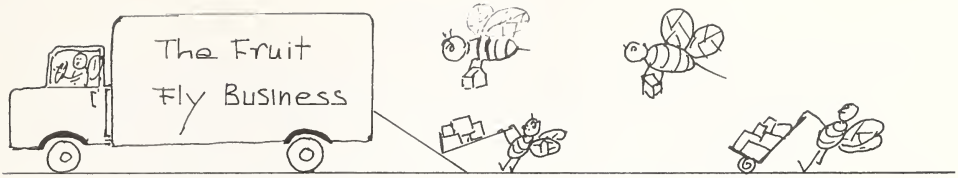
EXPERIMENT B: To use light as a factor in growing fruit flies.



You will need: 2 bananas
2 jars (approx. 1 L each)
1 hand lens
1 funnel
3 jars (approx. 250 mL each)
Pencils: 1 black, blue red and green

- Cut a peeled banana into three pieces. Place the pieces in a jar and fit the funnel into the neck of the jar. Let's call this jar a "fly trap".
- Place your fly trap outside (e.g. in an open area, on an outside window ledge). Leave it for a couple of hours. Check later to see how many fruit flies are in the jar. If you have 15-20, take your jar into the classroom. If not, leave it longer or try a new location.
- Cut your second banana unpeeled into three pieces and place it in a second jar. Transfer the flies to this jar. In the classroom observe the pieces of banana with a hand lens for a few days. Do you see some tiny white specks on the skins? They are fruit fly eggs!
- You will not need the adults now so you can let them free, outdoors.
- Transfer each section of banana with eggs to separate jars and cover. Label.
  Jar #1 — Place the jar in the room with ordinary light (not by a window).
  This is your control jar — it represents normal conditions.
  Jar #2 — Place this jar in a dark area e.g. in a box or cupboard.
  Jar #3 — Place in a brightly lit window but not where sun will warm it.
- Examine each jar every day and keep a record of any changes on the banana skins and the jar. The fruit fly has stages in its life cycle: eggs, larva, pupa and adult.
  Colour code your information: Jar #1 — blue pencil
  Jar #2 — red pencil
  Jar #3 — green pencil

LIGHT CONDITIONS																
STAGE	DAY															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
EGGS																
LARVA																
PUPA																
ADULT																



DIAGRAMS OF EACH STAGE			
EGGS	LARVA	PUPA	ADULT

STAGE	JAR #1	JAR #2	JAR #3
NO. OF DAYS IN EGG STAGE			
NO. OF DAYS IN LARVA STAGE			
NO. OF DAYS IN PUPA STAGE			
NO. OF DAYS FROM EGG TO ADULT STAGE			

- Is there a difference in the length of the life cycle using different temperatures? If so, in what way?

- What conclusion can you make about raising fruit flies using different intensities of light?

COLLABORATION:

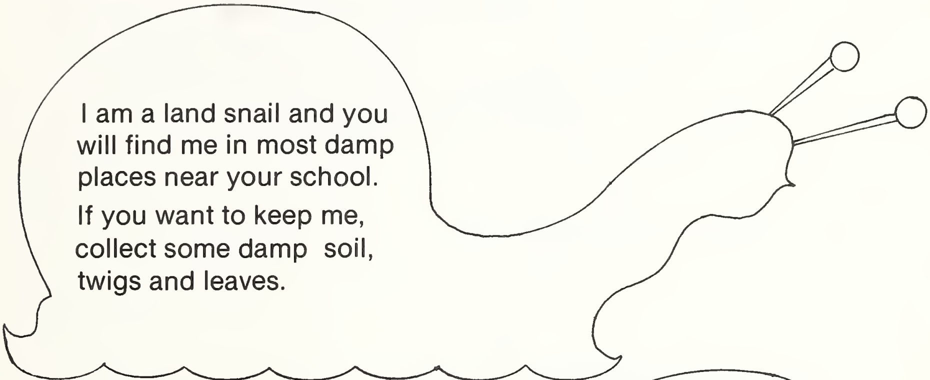
- Get together with the scientists in the other group. Compare your data.
- Is there a difference between the length of the life cycles, using the factors of light and temperature? Explain.

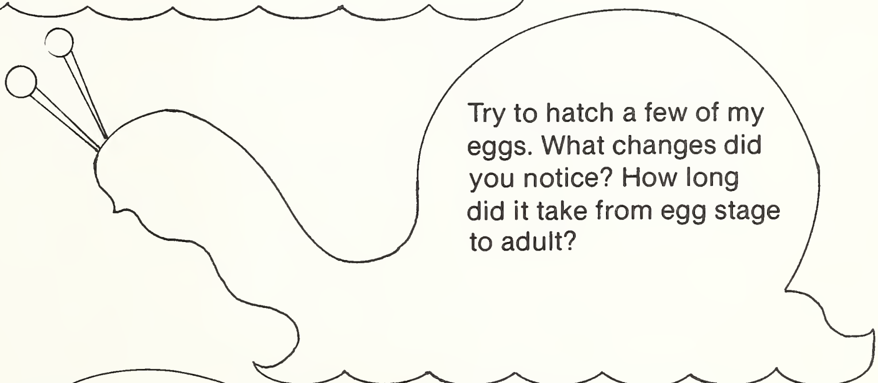
The commercial firm wanted you to advise them as to the quickest way to raise fruit flies. What information will you convey to them, based on your experiments?

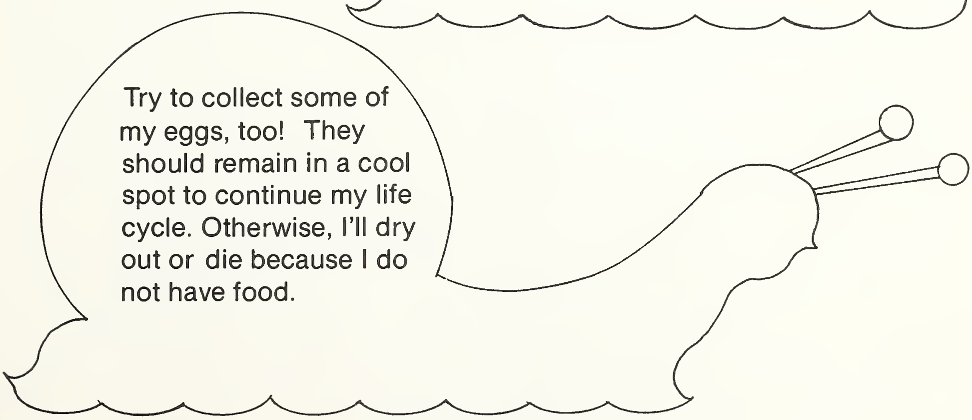
SNAILS

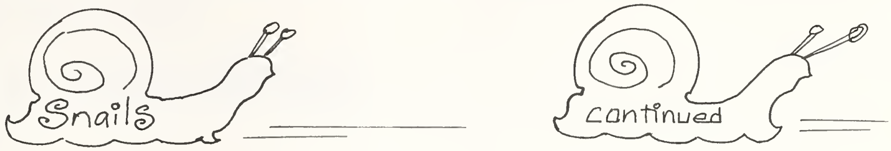
A snail is an animal whose soft body is usually covered with a coiled shell. There are more than 80 000 kinds of snails. Some are as small as a pinhead while others can be 50 cm long! Snails can be divided into three groups according to where they live: on land, in fresh water or in salt water. Most snails are harmless and are used for a variety of reasons. They can be a part of the food chain for birds and fish; the Helix garden snail, known as *escargot*, is considered a delicacy by humans. Others, if found in polluted waters near sewers, can carry diseases such as typhoid fever or hepatitis.

This activity card suggests ways that you can observe land and fresh water snails. You may find them fascinating!









I am a water snail and can be found in lakes, rivers and ponds.

If you want to keep me, take me home in pond water and transfer me into your aquarium.

I am well known for my meticulousness. Why am I popular as an aquarium "housekeeper"?

Put me on the side of your aquarium. How do I move? What do I look like? Look for my tentacles and eyes?

Small Living Things, Activity Card 25 (continued)

GREEN BOOK (5)
Unit 2: Your Body
Pages 48-95

UNIT OVERVIEW

Concept Development

In the preceding levels of the program, the following concepts were introduced and developed:

The human body has certain parts that help it carry on its life functions such as growth, responsiveness, metabolism and reproduction. In order to live and grow, people need food, water, air and a proper temperature. People learn about their environment through their senses. The way people respond to their environment is called behaviour. Behaviour can be instinctive or learned.

This unit develops the concepts that the body is a highly organized structure, composed of different kinds of cells, tissues, organs and systems that perform various functions. The *structures and functions* of the human body are *interrelated* and *interdependent*. Understanding how the human body works and the importance of various parts is necessary so that people can help their bodies function properly and efficiently.

Unit 2 "Your Body" consists of three chapters. Chapter one discusses the makeup of the human body with emphasis on the body's cells, tissues, organs and systems. The second chapter outlines the activities carried out by three of the body's vital systems — the circulatory system, the respiratory system and the digestive system. The things people can do to help their bodies work properly are discussed in chapter three.

Process Development

The material considered in this unit offers opportunities for students to use their bodies directly to *observe* and *investigate* the concepts that are being developed.

Students *observe* and *collect data* on the properties and characteristics of some tissues, organs and systems of the body. They use these *observations* and data to make *comparisons* and *inferences*. Then they *investigate* the nutrient value of a number of different foods and they use these investigations to *classify* foods into the four main food groups.

Throughout the unit, students describe observations and interpretations in writing, using drawings, or orally.

Related Units

Your Senses *Orange Book (1)*
Living Things *Orange Book (1)*
Food for Animals and You *Gold Book (2)*
Animal Behaviour *Blue Book (3)*
Interacting with Your Environment *Red Book (6)*
The Human Body — A Study of Yourself *Exploring Living Things (7)*

Materials and Advance Planning

The following list includes the materials that a student, or in some cases a group of students, will need to carry out the activities in this unit. In some instances, other materials may be substituted for those on the list.

Fresh, uncooked chicken leg; scissors; tweezers; waxed paper; watch with a second hand; paper; pencil; limewater; 2 wide-mouthed jars; 3 small balloons; large balloon; bicycle or ball air pump; clear plastic container; clay; plastic straw; rubber bands; large nail; sampling of a number of foods such as crackers, cookies, bacon, cheese, peanuts, margarine, apple, corn, raisins, lettuce, bread, potato, macaroni, boiled egg and meat; milk; cornstarch; eyedroppers; orange juice; lemon juice; carrot juice; corn syrup; tin can; hot plate; knife; brown paper bag; iodine; spoon; pot holder.

Check with the local high school for limewater and tes-tape or otherwise obtain it from a drugstore.

BACKGROUND INFORMATION

Chapter 1: What makes up your body?, pages 50-57

This chapter introduces the concept that the human body can be looked at in terms of *levels of organization*. The levels are the cells, tissues, organs and systems. The *relationship* between these levels is also developed.

Each cell in the body carries out certain basic functions. Some of these functions include taking in nutrients and oxygen, burning nutrients and oxygen, and giving off waste products. Other basic functions include repair, growth and reproduction. However, because cells are very small, they usually join and work together with other cells of the same kind. When the same kinds of cells join and work together to carry out specific jobs, those cells make up what is called tissue.

There are four main groups of tissues in the body. One group of tissue is called connective tissue. Generally speaking, connective tissue helps protect certain parts of the body, helps give the body form, and helps the body move. Four types of connective tissue are bones, cartilage, ligaments and tendons.

A second group of tissue in the body is called epithelial tissue. Epithelial tissue makes up the skin and the smooth lining of the mouth, the stomach, and the intestine. Epithelial tissue such as the skin protects the body against disease-causing organisms and other substances that might harm a person if they were to get inside the body. Epithelial tissue such as the lining of the stomach protects the underlying layers of the stomach against powerful digestive juices essential to the breakdown of food.

Muscle tissue forms a third group of tissue. There are three types of muscle tissue in the body. One type, which is found throughout the body and which makes up the largest portion of muscle tissue in the body, is called striated muscle. Striated muscle is the type of muscle that is connected to the bones and that enables a person to move. Another type of muscle tissue is called cardiac muscle. Cardiac muscle makes up the heart and is found in no other place within the body. Still another type of muscle tissue is called smooth muscle. Smooth muscle is found within the lining of such body parts as the stomach, the intestine and the urinary bladder.

In addition to connective tissue, epithelial tissue and muscle tissue, another group of tissue in the body is nerve tissue. Nerve tissue makes up the brain, the spinal cord and the many nerve cells throughout the body.

A higher level of organization occurs when certain kinds of tissues work together. Tissues that work together to carry out certain functions are called organs. The heart is an example of an organ. It is made up of several kinds of tissues including muscle, blood, and nerve tissues.

Most organs work together with other organs to form a higher level of organization called a system. Each system fulfills a specific function. Some examples of body systems are the respiratory system and the nervous system.

Chapter 2: Some systems of your body, pages 58-74

There are many important systems of the body. One system — the circulatory system — is responsible for carrying nutrients, oxygen and other substances to the cells of the body and is responsible for carrying waste products away from the cells of the body.

The circulatory system consists of the blood, the blood vessels and the heart. Blood transports nutrients and oxygen to all the cells of the body. Blood also picks up wastes from each cell and carries the wastes to organs such as the lungs, kidneys and liver that remove the wastes from the body.

Blood consists of several parts. The liquid part of blood is a clear, yellowish substance called plasma. Within the plasma are three kinds of solid materials — namely, red blood cells, white blood cells and platelets.

Red blood cells contain a substance called hemoglobin. Hemoglobin is the substance that picks up oxygen from the air within the lungs and carries the oxygen to each cell in the body.

The white blood cells in blood attack, and usually destroy, disease-causing organisms that get into the bloodstream. Platelets help blood clot wherever the body is injured and bleeding.

The heart is a powerful muscle about the size of a person's fist. The heart pumps about 9500 L of blood per day.

An elaborate network of blood vessels of various sizes makes the distribution of blood throughout the body possible. Oxygen-rich blood is pumped from the heart through thick blood vessels called arteries. (The major artery leading from the heart is called the aorta.) These arteries branch out all over the body, getting progressively smaller as they weave throughout the body. The arteries become so small that they can be seen only with the aid of a microscope. At this point, they are called capillaries. It is through the walls of the tiny capillaries that oxygen and nutrients pass from the blood to body cells and that carbon dioxide and other waste products pass from body cells to the blood.

The capillaries continue to weave throughout the body and then join into progressively larger blood vessels. These blood vessels are veins. The veins ultimately end up flowing into the vena cava, the largest vein in the body. The vena cava then carries the blood to the heart.

As the blood is pumped from the second chamber of the heart, the blood passes through the pulmonary artery. The pulmonary artery carries the blood to the lungs, where carbon dioxide is given off and oxygen is picked up.

The oxygen-rich blood then returns to the heart through four pulmonary veins, where it is then pumped out through the aorta once again.

Another important system of the body is the respiratory system. The respiratory system consists of the nose, the mouth, the pharynx, the trachea, the bronchi, the bronchial tubes, the bronchioles, and the alveoli.

Air breathed in through the nose or the mouth passes through the pharynx, or back portion of the throat. The air then passes down the trachea, or the windpipe, into two tubes. These tubes are called bronchi, and each one carries air to a lung. Within the lungs, the bronchi divide into progressively smaller branches called bronchial tubes. When these tubes become especially small, they are called bronchioles.

Attached to the bronchioles are tiny air sacs called alveoli. (The singular form of alveoli is alveolus.) It is through the alveoli that the exchange of oxygen and carbon dioxide occurs within the lungs.

The exchange of oxygen and carbon dioxide occurs in the following way: Around each alveolus are many capillaries. Oxygen that is breathed in is carried through the respiratory system to the alveoli. Oxygen inside the alveoli passes through them into the blood travelling through the capillaries. The oxygen is then transported to all the cells of the body. As the blood carrying oxygen

travels throughout the body, the cells of the body pick up the oxygen and give off carbon dioxide into the blood. The blood containing the carbon dioxide then returns to the lungs, where the carbon dioxide passes into the alveoli, then passes through the various air tubes, and finally is breathed out.

Breathing is accomplished mainly through the contracting and the relaxing of a large, flat muscle that separates the chest cavity from the abdonimal cavity, making the chest cavity airtight. This muscle is called the diaphragm.

When the diaphragm is tightened, it moves downward toward the abdomen. The downward movement increases the size of the chest cavity, thus decreasing the air pressure within the chest cavity. As the air pressure within the chest cavity is decreased, that pressure becomes less than the air pressure outside the body. The result of this unequal pressure is that the outside air rushes into the lungs, resulting in a person breathing in. Once the air pressure equalizes, the air no longer rushes in.

Breathing out is accomplished in a very similar manner. When the diaphragm is relaxed, it moves upward, decreasing the size of the chest cavity and therefore increasing the air pressure within the chest cavity. The air pressure within the chest cavity is then greater than the air pressure outside the chest cavity. As a result, the air within the lungs rushes out.

Another important system of the body is the digestive system. There are many organs of the body that make up the digestive system. The major organs are the mouth, the esophagus, the stomach, the small intestine and the large intestine.

The basic function of the digestive system is to break down foods into substances that can be used by the cells for growth, repair and energy. Such substances are called nutrients.

Digestion begins in the mouth where food is chopped, ground into small bits and mixed with saliva. Once food is broken into tiny pieces and mixed with saliva, the food is swallowed.

From the mouth, food passes through the pharynx into the esophagus. It is at the point when food is passing through the pharynx that food could present a potential danger to a person. The reason food can be dangerous when passing through the pharynx is that the opening to the trachea, or the windpipe, is also in the pharynx, and food could accidently be breathed in.

Once food is in the esophagus, the food is moved downward to the stomach by means of gravity and by means of strong, muscular movements. Such muscular movements are called peristalsis.

Food moves through the esophagus into the stomach. In the stomach, the food is mixed with digestive juices that break down the food into a thick liquid called chyme. Chyme is then moved out of the stomach into the small intestine by means of peristalsis. (The movement of food from the stomach into the small intestine usually takes about four and a half hours.)

Once is the small intestine, chyme is further broken down by digestive juices. In addition, the nutrients are picked up by the blood and carried throughout the body.

Some parts of food cannot be digested. These parts are called wastes, and they pass from the small intestine into the large intestine, along with a considerable amount of water. (The last of the wastes from the small intestine usually pass into the large intestine after about seven hours.) A large amount of that water is absorbed into the bloodstream for use by the body. However, some of the water along with the wastes are eventually eliminated.

Chapter 3: How can you help your body, work properly?, pages 75-91

Generally speaking, there are five kinds of nutrients in the foods that we eat. These nutrients are fats, carbohydrates, proteins, minerals and vitamins. Nutrients provide the body with energy, with essentials for growth and repair of body cells, and with essentials for keeping cells and organs working properly.

Nutrients that supply people with energy and heat include carbohydrates such as sugars and starches. Fats are also energy nutrients. In fact, fats produce about twice as much energy in the body as carbohydrates. However, when people eat more fats than they can immediately use, the excess fats are stored in the body. When fats are stored around some organs, such as the heart, the fats may cause such organs to be less efficient than normal.

Body cells are constantly growing, wearing out, or being damaged. Fortunately, the body can often replace or repair such cells. But to do so, the body needs proteins. Fish, chicken, nuts, and beans are foods high in this nutrient.

Also needed for proper cell functioning and growth are minerals and vitamins. Two important minerals are iron and calcium. Foods that are rich in iron are liver and raisins. Foods that are rich in calcium are cheeses and milk.

The body needs only a small amount of vitamins. But without that amount of vitamins, the body would develop deficiency diseases such as scurvy, beriberi or rickets. (Scurvy develops from deficiency of vitamin C; beriberi develops from a deficiency of vitamin B; rickets develops from a deficiency of vitamin D.)

A balanced diet, or a diet that provides all the nutrients a person usually needs, can be obtained by eating foods from each of the four basic food groups daily. The four basic food groups are the milk group, the meat group, the vegetable-fruit group and the bread-cereal group.

Besides eating foods from the four basic food groups, getting enough rest is also important in helping the body work properly. Rest is essential to health because when people are awake and active, wastes build up in the body cells. The body cannot eliminate the wastes fast

enough, so people become increasingly tired. Sleep gives the body a chance to catch up on waste removal and to replace or to repair body cells.

Physical activity is also essential for vigorous health at any age. For instance, regular exercise strengthens the heart. Exercise causes many capillaries in the heart and the lungs to widen. This allows oxygen to get to these organs and carbon dioxide to be removed from these organs quickly. Strong circulation of blood allows the body to recover quickly from hard work or exercise.

Not all exercise is equally useful in strengthening the circulatory and the respiratory systems. The best kind of exercise requires steadily repeated muscle movements over a sustained period of time. Examples of this kind of exercise are swimming, jogging, hiking, skiing and bicycling.

Still another thing people can do to help their body work properly is have physical checkups. Many children, as well as many adults, think that visiting a doctor only occurs when a person is sick. However, more people are recognizing today that preventive medicine through regular physical checkups can help people maintain optimum health. Minor problems may be corrected before they become serious. Major problems may be discovered before they become insoluble.

TEACHING STRATEGIES

The purpose of the following activities and teaching strategies is to provide you, the teacher, with a wide variety of suggestions that can be used, together with the material presented in the textbook, to help develop the processes and concepts of this unit.

Chapter 1: What makes up your body?, pages 49-57

— Pages 49-52 can be read and discussed.

— A simple visual aid could be prepared for a discussion about cells. Using a small glass jar or small glass, make a clear gelatin mold as per manufacturer's instructions. Just before the gelatin solidifies, insert a drained cherry or olive in the centre of the gelatin to represent a nucleus. Students could estimate how much larger this cell is than a real cell.

— Slides showing blood cells and tissue cells could be obtained from:
a local high school
a pathology laboratory
a medical supply company
the local health department
a histology laboratory of a university

The cells can be observed under a microscope. The following questions could be posed: Do all of the cells look alike? If they differ — how do they differ? Drawings can be made to illustrate observations.

— Pages 52-56 Tissues, can be read and discussed.

— The suggested activity on page 55 gives students an opportunity to compare the muscle of a chicken's heart and stomach with the muscle tissue of the chicken's leg. Students could design their own method of reporting their findings.

— Students could conduct an activity related to the muscles of expression. This activity draws awareness to the location of various facial muscles and, which muscles are used when we appear surprised or angry, when we scowl, wink, smile or frown. "Activity Card 1, Muscles of Expression" has been provided.

— Students may wish to use a diagram showing body muscles to discover which muscles are used when (a) we chew (b) we flex our upper arm and (c) we grasp an object with one hand.

— A worksheet has been included for the "Finding Out" on page 56, in the activity book (page 11).

— To assist the children to understand the purpose of nerve tissue, you could have them participate in these activities:

(a) Have blindfolded children describe and identify various objects with their bare feet.
(b) Have the children sit in a circle and remove their shoes and socks. Place a bath towel, fur, sandpaper, cellophane and a dry sponge on the floor in the centre of the circle. Have the children close their eyes and then walk the children across the different surfaces one at a time.
(c) Have children close their eyes and have them arrange different grades of paper from rough to smooth. (You could use coarse sandpaper, medium sandpaper, construction paper, mimeograph paper, tissue paper and crepe paper.)
(d) Blindfold volunteers and ask them to place one hand in the cold water and the other in the hot. Then have them place both hands in the warm water. Ask them to describe what they feel.

— Page 57, Organs and Systems, can be read and discussed.

— You might wish to mention the availability of organ banks. Pamphlets regarding donor banks can be obtained from your local motor vehicle branch, hospital or health unit. A discussion could be held of these questions:

(a) Why do these banks exist?
(b) Why do people decide to donate a particular organ?
(c) Can "living" donors contribute too?
(d) Are there any age limits for donors?
(e) How do the authorities know who wishes to be a donor?

Chapter 2: Some systems of your body, pages 58-74

— Pages 58 and 59 can be read and discussed.

— The Red Cross blood donor service could be mentioned. Perhaps some of the students' parents or relatives have donated blood. A representative from the Red Cross could visit the classroom to explain:

(a) the purpose of the Red Cross and its blood bank
(b) blood donors, blood types
(c) how blood is collected and stored.

— If students research the purpose of platelets in the Exploring on Your Own activity (page 59), the following questions could be posed:
  (a) When blood does not clot quickly, what is the condition called? (Hemophilia)
  (b) What is a person called who suffers from this condition? (A hemophiliac)
  (c) What are the symptoms of hemophilia? (Abnormal bleeding, prolonged clotting action)
  (d) Suppose a person who is bleeding informs you that he or she is a hemophiliac. What would be your first action? (get medical aid immediately; have someone call an ambulance; obtain medical assistance from a doctor, nurse or certified first aid person if they are on the scene)
  (e) How can the Red Cross help hemophiliacs? (provide blood for transfusion purposes.)
— Read and discuss page 60, Your heart.
— The children can discover the approximate size of their own heart. You could suggest that they close one hand and place the fingers of the other hand around the closed hand.
— A worksheet for the "Finding Out" on page 61, can be found in the activity book (page 12).
— You may wish to have the students listen to each other's heartheat and record their findings. (The heart beats approximately 72 beats per minute.)
— "Activity Card 2, The Heart Specialists" has been designed to encourage students to research topics related to the heart. Students can work in pairs or in small groups on the activity that interests them.
— Pages 61-63, Your blood vessels, can be read and discussed.
— Working in pairs, students could make an outline of each other on large pieces of coloured paper and then cut out the figures. One of the students can use a coloured pencil to draw the main veins on one of the body outlines. The other student can use a different coloured pencil to show the arteries on the other body outline. Wool of the same colour then can be glued to the pencilled lines. The drawing shown on page 62 can be used as a guide.
— Pages 64-68, Your respiratory system can be read and discussed.
— A Worksheet for the "Finding Out" on page 67 is available in the activity book (page 13).
— To extend the knowledge that air passes through the nose as a part of the respiratory system, the students could research information to answer the questions posed on "Activity Card 3, The Nose Knows". They may wish to investigate one or all of the activities. (Answers: (1) The air is filtered, warmed and moistened. (2) The filtering system collects foreign particles before they reach the lungs; the mucus in the nose gives heat and moisture to incoming air and serves as a trap to bacteria. (3) The seal and the camel can close their noses.)
— Students may be interested in investigating some conditions related to the respiratory system. These conditions are common topics today and the information obtained by the students could be used as "preventive medicine". "Activity Card 4, "What Happened?" offers six investigations for research. Students could attempt one or more of the activities. The answers follow:

Sneezing: (1) A sneeze is a sudden expiration of air through the nose. (2) It is caused by irritation of nasal nerves or overstimulation of the optic nerve by a very bright light.

Lungs: The lungs of a non-smoker are pinkish in colour and the lungs of a smoker are gray and mottled.

Running: The runner may need several times as much oxygen as his body can absorb during the race. However the muscles continue their work without additional oxygen for a limited period of time. At this time, the runner has built up an oxygen debt. When he stops, the runner will breathe hard for several minutes until the oxygen debt is repaid. At this time he acquires his "second wind".

Nosebleed: (1) A nosebleed is a hemorrhage from the nose. When small blood vessels break, bleeding results. (2) It is sometimes caused by excitement OR a blow which breaks a blood vessel.

Emphysema: (1) Emphysema is a disease of the lungs. (2) It is caused by carbon dioxide remaining in the lungs when a person exhales, taking up space usually occupied by inhaled air. The person must breathe harder to get a normal amount of oxygen into his lungs. Possible causes are smoking or air pollution. (3) Symptoms: shortness of breath or difficulty in breathing.

Smokers and Cancer: Many tobacco smokers inhale smoke into the lungs. The smoke irritates the lining of the air passages and weakens the tissues.
— A worksheet for the "Finding Out" on page 69 can be found in the activity book (page 14).
— Pages 70-74, Your digestive system, can be read and discussed.
— You could pose this question: If juices from the walls of the stomach can break down food, why isn't the stomach itself digested? (Small amounts of ammonia are secreted by cells in the lining of the stomach and this chemical can counteract the effects of normal amounts of hydrochloric acid on the membrane.)
— The students might wish to investigate the difference between a cow's or a sheep's stomach and a man's stomach.
— You might ask the students: What does it mean when a person says that their stomach is "growling"? (The person is talking about the peristaltic waves in an empty stomach. These are wavelike muscular contractions which move the food through the digestive system.)

Chapter 3: How can you help your body work properly?, pages 75-91

— Pages 75 to 78, can be read and discussed.
— Results for the "Finding Out" (page 77) can be recorded in the activity book (page 15)
— You may wish to have students test foods for starch. An experiment has been included on "Activity Card 5, Testing for Starch."
— Students could use "Activity Card 6, Searching for Sugar." This activity uses Tes-tape to determine if foods contain sugar.
— You may wish to ask your students why strawberry jam and packaged gelatin desserts do not belong to a food group.

(Gelatin desserts: Sugar is the only ingredient present in large amounts. Strawberry jam: It is low in nutritional value and high in sugar (65-70%) and calories.)

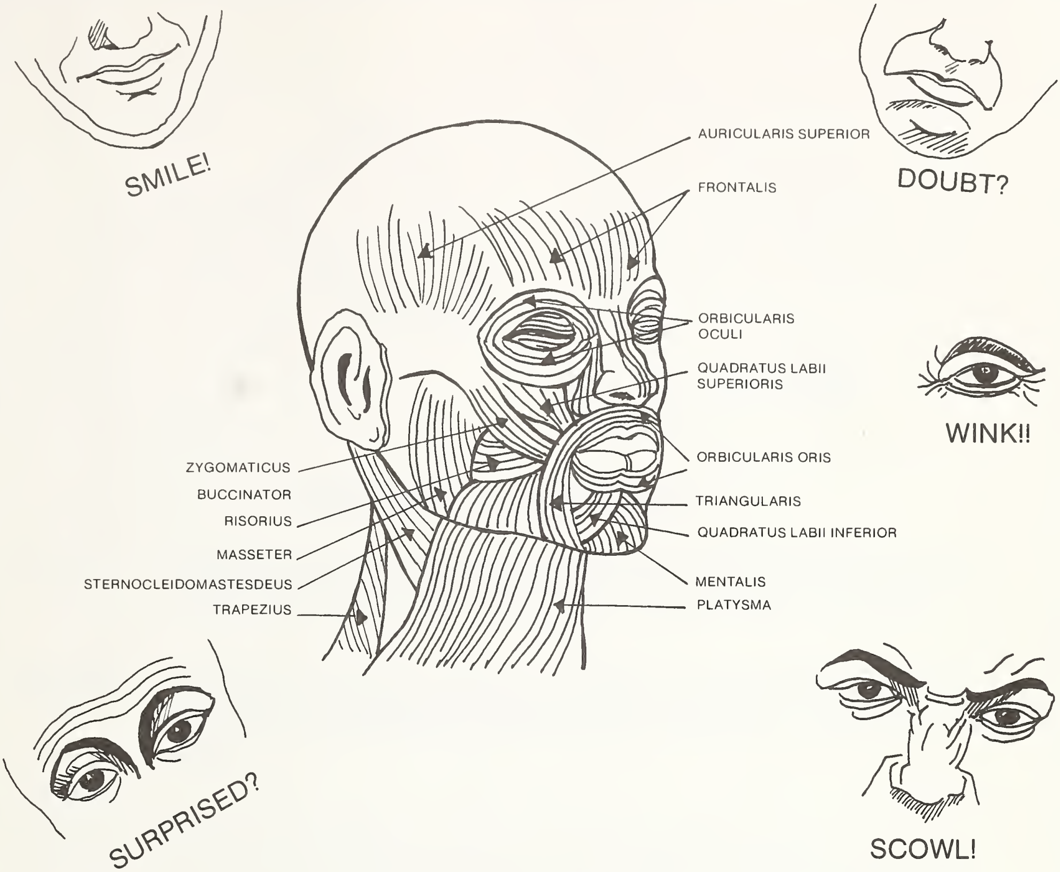
— Results for the "Finding Out" (page 79) can be recorded in the activity book (page 16).
— Pages 79 to 82 can be read and discussed.
— To demonstrate how much calcium children have in their bodies at different ages you could make up some calcium bags. You can use flour as the calcium and measure the following amounts into plastic bags:

A newborn baby	— 70 mL
A 10 year old	— 600 mL
A 15 year old	— 1400 mL

Boys and girls have the same amounts of calcium in their bodies.

— "Activity Card 7, Did You Know that Bones Love Calcium?" will demonstrate to your students how the presence and absence of calcium affects bones.
— Results for the "Finding Out" on page 82 can be recorded in the activity book (page 17)
— Pages 83 and 84 regarding vitamins can be read and discussed.
— Students could conduct the research idea at the bottom of page 83.
— Students could conduct a vitamin survey. See "Activity Card 8, Vitamin Survey".
— "Activity Card 9, He is what he eats" asks students to think about the value of proteins and minerals as they relate to a hockey player's diet. Perhaps they can name a few hockey players who are extremely careful about their diets. You may have to explain the meaning of the word "psychological" before assigning this activity card.
— Pages 84 and 85 can be read and discussed.
— Using provincial maps, students could use a code system to mark the location where foods in each food group are produced in your province. E.g. Strands of yellow wool could radiate out from the words "Milk Group" to areas where dairy products are produced; strands of green wool would radiate out from the words "Meat Group" to show the livestock-raising areas of your province, etc. This idea could be extended and used as a research activity to learn the location of these products in Canada. The maps could form a bulletin board display.
— Pages 88-92 can be read and discussed.
— You may wish to have the students play the game *"The Great Hunt"*. Each student in the class writes the name of a food on a piece of paper. Each student pins a paper on the back of a friend. Then the students attempt to find out the names of the foods pinned to their backs. They can only ask questions which can be answered by "yes" or "no". They could ask a friend "Am I in the meat group?" or "Do I contain carbohydrate?".
— Some of the more able students could form small groups and discuss these statements:

(1) A person can be well-nourished and still not be physically fit BUT HE CAN NEVER BE PHYSICALLY FIT WITHOUT BEING WELL NOURISHED.
(2) Many Canadians suffer from nutritional deficiencies even though we have ample food.
(3) In Canada, we have many nourishing foods but our lifestyle often inhibits physical activity.
(4) Obesity is Canada's number one nutritional problem. What are the causes of obesity?

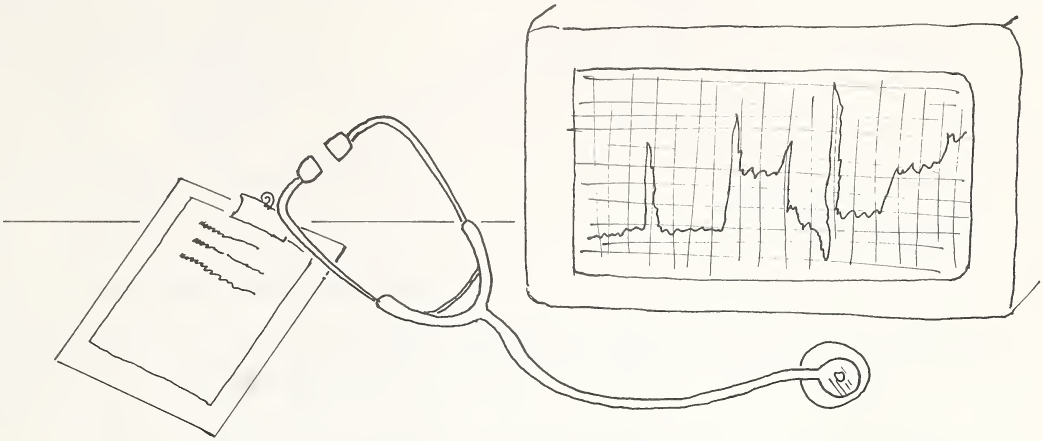


MUSCLES OF EXPRESSION

For every expression that we portray on our face, we use a variety of muscles.

You can see these muscles at work if you look at yourself in a mirror.

- Look at yourself in the mirror and give a big smile!
- Note which muscles are being used.
- Look at the diagram and try to pronounce the names of these muscles. You are right — they are big words but try to learn to pronounce at least one of them. You've added a new word to your vocabulary!



The Heart Specialists

TEAM A — Trace the flow of blood in and out of the left side of the heart. Make a diagram to illustrate your information. Share it with your class.

TEAM B — Trace the flow of blood in and out of the right side of the heart. Make a diagram to illustrate your information. Explain your diagram to the class.

TEAM C — What is a "blue baby"? You can use a visual aid to explain this to your classmates. If you wish, you could use a model or an overhead transparency.

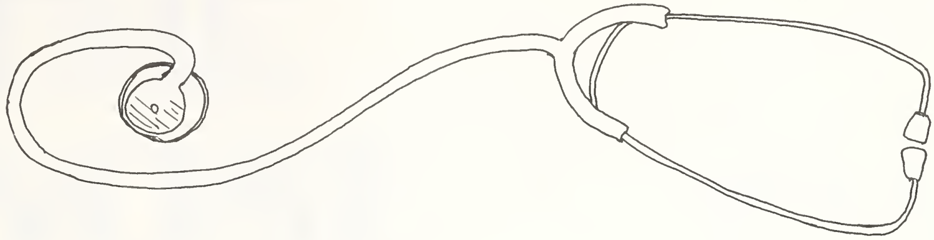
TEAM D — Compare the size and weight of the heart of a cow, a chicken and a human. Make a chart to show their sizes. How could you show your classmates the weight of each heart?

TEAM E — Why do heart murmurs occur? Present your information to the class using a model of a heart or pictures.

TEAM F — Imagine that you are a famous heart specialist. Relate your role and your accomplishments to your classmates.

You may need to research current magazines and the encyclopedias in your library to gain information. Try to find pictures of this person, too.
Some famous heart specialists include Dr. Denton Cooley, Dr. Christian Barnard and Dr. Michael DeBakey.

Your Body, Activity Card 2



The Heart Specialists (continued)

TEAM G

Your group will form a panel. You will present your views to the rest of the class.

Three of you believe that it is **necessary** to use animals in a laboratory to test artificial hearts **before** they can be implanted into humans.

The other three members believe that animals should **not** be used to test artificial hearts before they are implanted in humans.

It would be wise to research the topic and collect some facts to support your view. Ask other adults, classmates, scientists and medical personnel about their opinions on this topic.

TEAM H

Your group will be discussing the pros and cons of the cost of scientific research to develop artificial hearts.

Two of you believe that the cost of scientific research is justified — even if it saves only one life!

The others believe that this money should be spent on food for people who are starving.

Try to get ideas from others about your topic. You might wish to ask scientists, medical personnel, a minister or priest, a veterinarian, a pathologist, a policeman, an ambulance driver, a construction worker, an office worker, etc.

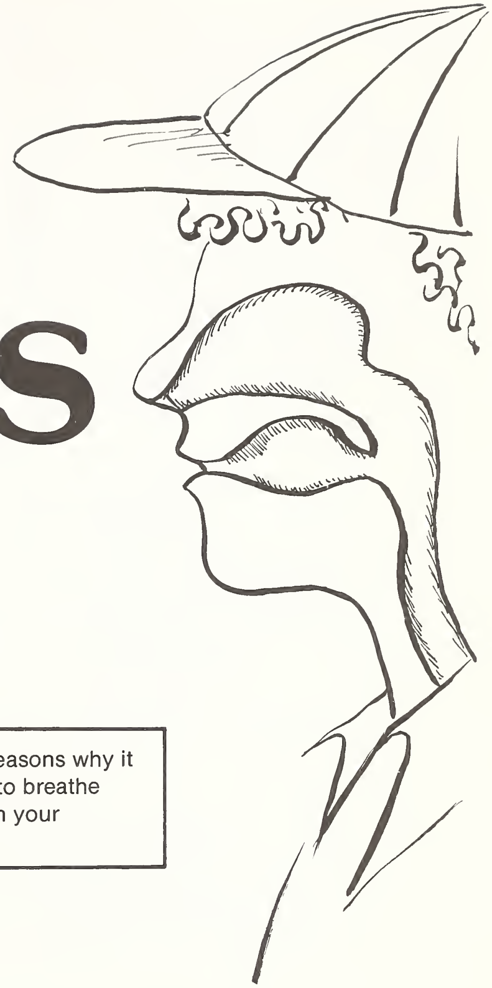
Your classmates may want to vote on these views. Think wisely!

TEAM I

Your team is to construct a "working model" of a heart. You might find ideas for your model in an encyclopedia.
Think! What could you use to show that blood flows?
Present your model to the class.

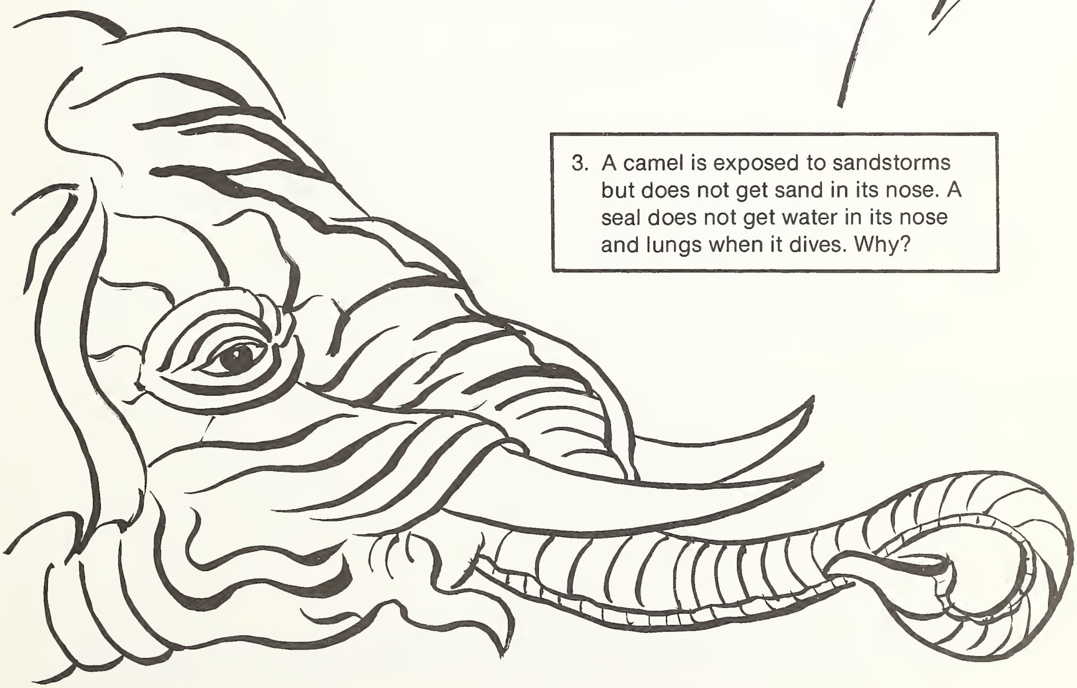
Your Body, Activity Card 2 (continued)

THE NOSE KNOWS

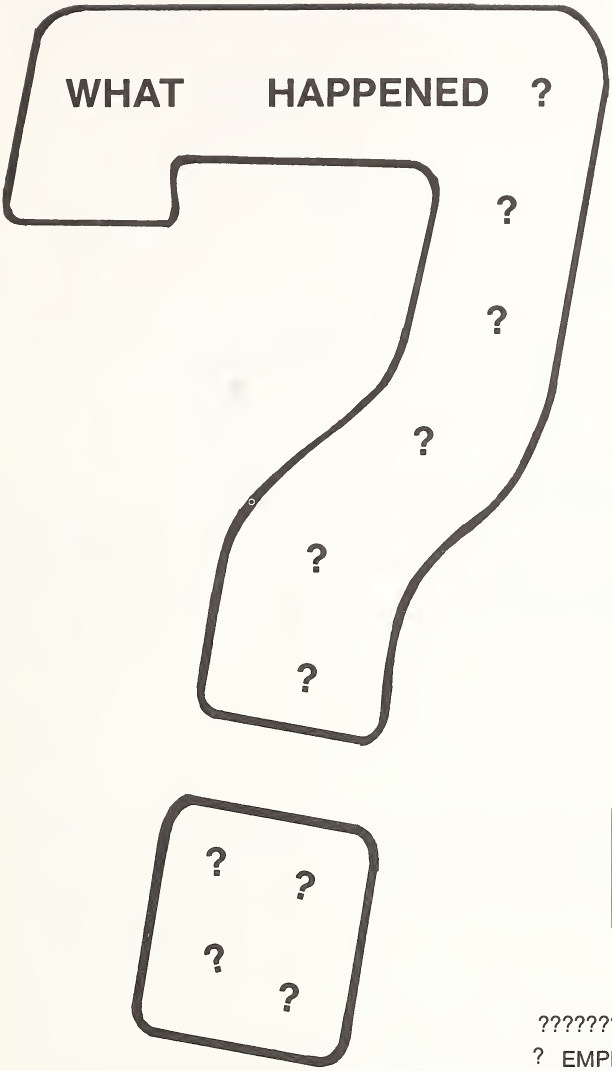


1. The nose has been compared to an air conditioning unit. Can you think of three reasons that make this statement true?

2. Can you think of two reasons why it is more advantageous to breathe through your nose than your mouth?



3. A camel is exposed to sandstorms but does not get sand in its nose. A seal does not get water in its nose and lungs when it dives. Why?



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SNEEZING

What is a sneeze?
What causes sneezing?

???????????????????????

LUNGS

Investigate the characteristics of a non-smoker's lungs and a smoker's lungs.

???????????????????????

RUNNING

What do runners mean when they say that they had to stop to get their "second wind"?
How can this be prevented?

???????????????????????

NOSEBLEED

Explain the term nosebleed. What causes it?

????????????????????????

EMPHYSEMA

What is emphysema?
What causes it?
What are the symptoms?

????????????????????????

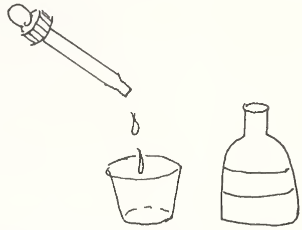
SMOKERS AND CANCER

Why are smokers more susceptible to cancer of the lungs than non-smokers?

If you know the causes of the above conditions — it will help you to avoid these conditions. Doctors call this "preventive medicine" — the best kind of medicine!!

Your Body, Activity Card 4

TESTING FOR STARCH



Starch is **one type** of carbohydrate.

You will need: 30 g of cornstarch
125 mL of water
iodine
measuring spoons
7 paper cups
eyedropper
skim milk powder, cheese, peanuts, bread, orange, white chocolate, corn

- Place 30 g of cornstarch in a paper cup.
- Add 125 mL of water to the cornstarch and stir.
- Add a few drops of iodine to the cornstarch mixture using the eyedropper.
- What colour is the cornstarch mixture?

- Place each of the other foods in a separate cup. Some of these foods will have to be crushed (e.g. cheese, peanuts, bread, orange, chocolate and corn).
- Place a few drops of iodine on the foods to be tested. If the foods contain starch a purple colour will appear.

  Which foods contained starch?

Try testing other foods for starch. Record your findings here:

FOOD	CONTAINS STARCH ✓ or X	FOOD	CONTAINS STARCH ✓ or X

SEARCHING FOR SUGAR

You will need: orange juice
lemon juice
carrot juice
corn syrup
Tes-tape (This is available from a pharmacy.)

- Touch each food with the Tes-tape. Wait a minute. Your tape will turn green if it touches a simple sugar.
- Record your findings on the chart below.

FOOD	COLOUR OF TES-TAPE
orange juice	
lemon juice	
carrot juice	
corn syrup	

- Analyze the data that you have collected.
Which of the foods contained sugar?

Which of the foods did not contain sugar?

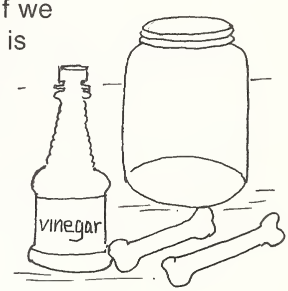
- What other foods do you think contain sugar?
Test them and record your findings on the chart below.

FOOD	COLOUR OF TES-TAPE
1)	
2)	
3)	
4)	

Your Body, Activity Card 6

“Did you know that . . .

BONES love CALCIUM?



At least sixteen major minerals are needed by our bodies if we are to have good health. One of these minerals is **calcium**. It is important because it makes strong bones and teeth.

You and two other friends can perform this experiment to discover:

(1) how the presence of calcium makes strong bones and
(2) how the absence of calcium results in weak bones.

You will need: 2 chicken bones
Jar (large enough to hold a bone)
Vinegar (a sufficient quantity to cover the bone)

- Feel one of the chicken bones. See how strong it is. This bone does not bend because it has calcium in it to make it strong.
- Place the other bone in your jar and cover it with vinegar. (This bone will be kept in the vinegar for about 2 weeks.)
- After one week has passed, remove the bone each day and try to bend it. Return it to the vinegar after examining it each day.

What happened each day when you tried to bend the bone?

Why did the bone bend so easily at the end of the two weeks?

Why do you think the whole bone didn’t dissolve?

VITAMIN SURVEY

Vitamins help the other nutrients to do their job. Some people feel that they should take vitamin pills to supplement their diet. They may take one or more kinds of vitamin pills. As an example, they may take Vitamin A and Vitamin C pills. They might also take "multiple" vitamin pills which contain a balance of all the vitamins.

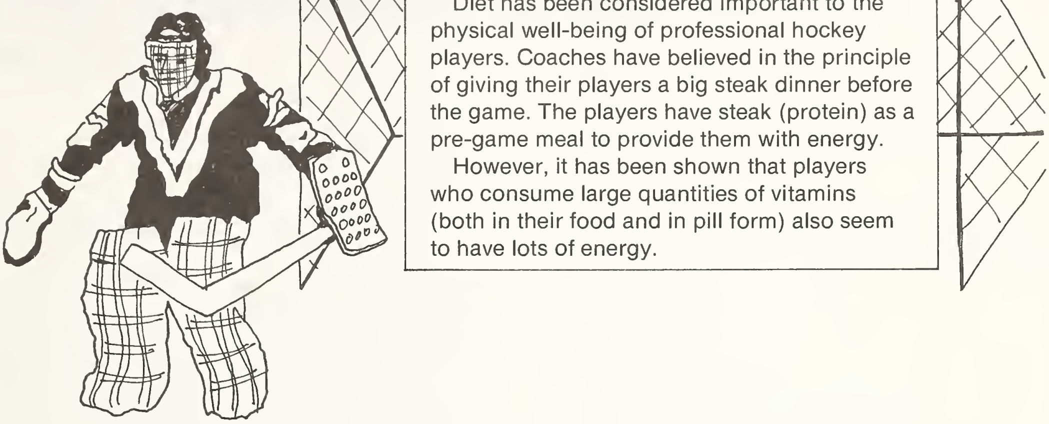
- Invite five students and five adults to take part in a vitamin survey that you are conducting. You could ask them (1) if they take vitamin pills and (2) if so, what vitamin pills do they take — single vitamins or multiple vitamins. You can use this chart to collect your information.

NAME	STUDENT or ADULT	VITAMINS A, B_1, B_2, C, D, K, or Niacin	MULTIPLE VITAMINS	NO VITAMINS	REASON
E.G. Bruce	S	C	—	—	To prevent colds

- Study the information that you have collected.
- Which age group takes the most vitamin pills?
- How many people are taking single vitamin pills?
- How many people are taking multiple vitamin pills?
- Can you suggest a reason why they take one type more than the other type?

- If you eat a well-balanced diet, do you think it is necessary to take vitamin pills? Explain your view.

HE IS WHAT HE EATS



Diet has been considered important to the physical well-being of professional hockey players. Coaches have believed in the principle of giving their players a big steak dinner before the game. The players have steak (protein) as a pre-game meal to provide them with energy.

However, it has been shown that players who consume large quantities of vitamins (both in their food and in pill form) also seem to have lots of energy.

1. Do you think that hockey coaches should change the pre-game diet of the players? Explain your view.

2. Do you think that the pre-game meal of steak has psychological value as well as nutritional value? Explain.

3. Do you think that hockey players should eat only for "instant energy"? Why?

4. What foods would you suggest that a hockey player eat in order to maintain energy on or off the ice?

5. Make a collage of these foods around a picture of your favourite hockey player.

Your Body, Activity Card 9

GREEN BOOK (5)
Unit 3: Electricity on the Move
Pages 96-143

UNIT OVERVIEW

Concept Development

In the preceding levels of the program, students were introduced to a number of forms of energy, namely magnetic, heat (radiant) and sound energy. They considered how these forms of energy were produced and studied some of their properties.

The content and activities in this unit provide a good way to develop an understanding of the concept of *interaction between objects and systems.* These interactions result in *changes* that can be *observed, measured, reproduced* (under the same conditions), *predicted and explained.* For example, in an electric circuit consisting of a battery and a bulb, the battery expends energy and the bulb lights up.

As students develop an understanding of electricity, they will have a better grasp of the nature of matter. Fundamentally, matter is electrical. Another important concept in this unit is that advances in science and technology have had a major impact on how people live. However, it is essential that we use good judgement in how we utilize these advances. Wise use of energy will be necessary to maintain a quality of life on this planet.

Unit 3 "Electricity on the Move" consists of four chapters. Chapter one discusses the difference between static and current electricity. Also discussed is how current electricity is produced. Chapter two defines the terms "conductor" and "insulator". It also discusses how circuits may be set up in series or parallel, and how these circuits differ from each other. Methods to control electricity by means of switches, fuses and circuit breakers are presented in Chapter three. An explanation of how electricity is measured is also included. The fourth chapter discusses the many uses of electricity.

Process Development

An understanding of electricity is best obtained through activities. Many of the investigations in this unit will help students develop a *mental model* of the major concepts. Students *observe* some of the properties of static electricity (page 100), and they *experiment* with bulbs in a series circuit (page 110). They use this *data* to *demonstrate* whether a parallel circuit or a series circuit is better for homes (page 113).

Students also *make models* of a number of electrical devices, namely — a battery (page 102); an electrical switch (pages 116 and 120); a fuse (page 122); an electric bulb (page 129); and an electro-magnet (page 130).

Related Units

Magnets *Gold Book (2)*
Heat and Temperature *Blue Book (3)*
Sounds Around You *Blue Book (3)*
Changes in Energy *Red Book (6)*
Energy: For Work and Motion *Exploring Matter and Energy (7)*

Materials and Advance Planning.

The following includes materials that a student, or in some cases a group of students, will need to carry out the activities in this unit. In some instances, other materials may be substituted for those on the list.

Hard rubber comb; bits of paper; balloon; woollen sweater; fluorescent bulb; piece of nylon; compass; bell wire; galvanized nail; copper nail or other thin piece of copper; lemon; two 1.5 volt batteries with posts; four 1.5 volt flashlight bulbs and sockets; objects such as iron nail, key, silver earring or silver dollar, aluminum foil, piece of wood, plastic toy, pencil; cardboard; scissors; paper fasteners; paper clips; cork stopper; thin strip of aluminum foil from a gum wrapper; wide-mouthed glass bottle; cork for the bottle; direct-current switch; strand of very thin picture wire; long, thin nail; large iron nail; pins.

The additional activities suggested in the resource guide require: Pieces of silk cloth, wool cloth, cotton cloth and nylon cloth; a leather glove; a stopwatch; 2 "D" cells; 1 dead "D" cell; 20 cm bell wire; milk carton; knitting needle; string; wirestripper; #20 bare copper wire; an electrical switch; strips of wood; wood screws; brass paper fasteners; cork and paper cups.

BACKGROUND INFORMATION

Chapter 1: All charged up!, pages 98-105

Most people have experienced a slight shock when touching a metal doorknob after scuffing across a carpet or have heard the crackling sound of clean, dry hair when it is combed. The shock and the crackling sound are examples of static electricity.

Static electricity results when certain objects rub together. That is, every object contains tiny, invisible electrical particles called electrons. When two different

objects are rubbed together, some of the electrons may rub off one object and go to the other and stay. When this occurs, the objects are electrically charged and therefore may attract lightweight objects such as feathers, bits of paper or thread.

Static electricity is common but it is neither reliable as a source of power nor easily managed. For these reasons another type of electricity (one that can be made to move along wires) is used by people. This is *current electricity.*

Current electricity is usually provided by one of two sources — batteries or power plants. Batteries generate electricity through chemical reaction.

In a car battery, for example, two kinds of metal plates are put into an acid solution. As the acid reacts with the metal plates, electricity is produced.

In a flashlight battery, chemicals in the form of a moist paste are used in place of the liquid acid used in a car battery. Also, a carbon rod is used in a flashlight battery in place of the metal plates used in a car battery. However, the principle of generating electricity is similar in both kinds of batteries.

Large electric power plants generate electricity by using waterpower or steam that forces a huge wheel to turn. A wire connected to the whirling wheel continually cuts across the field of a powerful magnet. This causes electrons in the wire to move and so generate electricity.

Coal, oil, natural gas and atomic power are the main sources of energy used to produce steam. However, a few geothermal power plants use steam that is produced by the extreme heat found within the earth.

Chapter 2: Pathways for electricity, pages 106-113

Materials through which electricity passes easily are called conductors. Most metals conduct electricity well, but some metals are better conductors than others. Copper is generally considered the most efficient metal conductor of electricity available at a reasonable cost. Therefore, copper is widely used for electrical wiring.

Materials through which electricity passes very poorly or not at all are called insulators. Most nonmetals are insulators. Rubber, cloth and plastic are especially useful insulators. It is for this reason that electric wires are covered with one of these materials. It is also why electricians wear rubber gloves when working around "hot" wires (wires through which electricity is passing).

Although some materials are normally poor conductors, those materials can become good conductors when wet. Human skin is one such example. For this reason electrical appliances should only be handled with dry hands.

Electricity can flow only when a wire, an appliance and a power source form a circuit — or an unbroken path. For example, to make a light bulb work, a wire, a bulb and a battery must be continuously joined. To detach any of these items breaks the circuit, causing the bulb not to work.

There are two kinds of electrical circuits. One is a series circuit and the other is a parallel circuit.

In a series circuit, all the electricity flows through each bulb one after the other. Therefore, if one bulb is removed, the circuit is broken and all the lights go out. In addition, each time a bulb is added to a series circuit, all the bulbs in the series become dimmer. This dimness results from the increased resistance the electricity must overcome when it flows through every bulb.

Unlike a series circuit, a parallel circuit is wired so the electricity can move both through and around bulbs. If a bulb is removed, the electric current continues to flow and the remaining bulbs keep working. There is little or no change in bulb brightness as more bulbs are added to the circuit because there is no increased resistance. This is because the current goes directly to each bulb without having first to go through other bulbs.

Circuits within most buildings are wired in parallel, which allows people to control each appliance separately. Thus, people avoid plunging an entire building into darkness when a single appliance is turned off.

Chapter 3: Controlling and measuring electricity, pages 114-125

Although removing a bulb or a wire will break a circuit, a circuit can be more safely and more conveniently broken by using a switch. In fact, a switch is an extremely useful device for making or breaking an electrical circuit.

There are many kinds of switches. For example, there is the flip switch that turns appliances off and on. In addition, many homes have paired switches that are used to control a single light from either end of a long hallway or from an upstairs location and a downstairs location. There are also switches that require constant pressure in order for electricity to flow, such as in a door-buzzer switch.

When electricity flows through a wire, the electrons must overcome the resistance of the metal to their flow. The small amount of friction involved causes the wire to heat up slightly. Normally, this heat is so slight that it presents no problem. However, under certain conditions, the heat generated due to resistance increases dangerously.

One condition that can generate a dangerous amount of heat is a short circuit. This may result when two wires touch each other at a place where the insulation is worn off both wires. The main supply of electricity surges through the shortened circuit, bypassing the limiting effect imposed by the appliances in the system. This almost unrestrained surge of electricity may cause the wires to become dangerously hot.

Overloading a circuit is probably an even more frequent condition that causes overheating. Older buildings and especially older homes may contain thin, lightly insulated wires designed for use at a time when only a few household appliances were available for use. Today, as more and more appliances are plugged into these thin, lightly insulated wires, the wires may overheat to the point of causing a fire.

Fuses and circuit breakers are designed into wiring systems. They protect people from potential fires due to overloaded circuits or short circuits. A screw-in-type fuse contains a thin strip of metal that melts at a relatively low temperature and through which the electric current passes. If the wires heat up, the metal strip melts and the circuit is broken.

Modern homes usually have circuit breakers in their wiring systems. When heated, one kind of circuit breaker is designed to bend one end away from a contact in the circuit. This breaks the circuit. Another kind of circuit breaker operates an electromagnet. Whenever an excessive amount of electricity surges through wires, the electromagnet pulls up a metal rod, which breaks the circuit. Both kinds of circuit breakers may be reset by hand after the source of trouble is corrected.

The amount of electric power used by consumers is usually measured in kilowatt-hours. Ten 100-watt bulbs will use 1000 watts in an hour, or one kilowatt-hour of electricity. An electric frying pan or a waffle iron also may require this much electricity in that amount of time.

Each household wiring system is connected to a meter measuring the amount of power used over a certain time period. Someone periodically checks the meter and reports the reading to the electric company which then sends a bill to the consumer.

Like water in a hose, electricity can be made available at different levels of pressure or force. The unit of force in electricity is called a volt. In Canada, many homes receive electricity at a force of 110 or 120 volts. This is ample for most electrical needs but may be inadequate for such heavy users of electricity as washing machines and clothes dryers. So, many homeowners have installed a special, separate wiring system. This system consists of extra-thick, highly insulated wire. Such a wiring system is essential in order for it to carry electricity at a force of 220 or 240 volts as some of the heavier appliances require.

Chapter 4: How does electricity help you? pages 126-139

Although metals conduct electricity well, they still resist the flow of electricity. In fact, a few metals resist the flow of electricity so much that they heat up rapidly and even glow when there is enough voltage to force a current through the metal. Some examples of appliances that make use of electricity in this way are toasters and hair dryers.

Besides the kind of metal used, the diameter and the length of a wire are other factors that increase resistance. A narrow wire constricts the flow of electricity. As the electrons "crowd" through the wire, the wire heats up faster than a thick wire does. When a wire is lengthened, there is more friction to overcome, so more force is required to "push" the electrons along the wire. For these reasons, most devices that produce heat have relatively long, thin wires made of highly resistant metals.

One metal that is extremely resistant to electricity is tungsten. It is commonly used for the filament in incandescent bulbs. In addition to being resistant, tungsten is also very durable. A tungsten filament can be made to last even longer by pumping a gas into the bulb that retards the burning of the tungsten.

Some electric bulbs do not contain wire filaments. Electric signs frequently have narrow tubes filled with a gas, such as neon, that glows when electricity flows through the gas. Different gases are used to produce different colours.

Fluorescent lights work in a similar way except that substances called phosphors are painted on the inside surface of the light. It is the phosphors that glow rather than the gas within the light.

Besides producing light and heat, electricity can also be used to make a kind of magnet called an electromagnet. When insulated wire is wrapped around an iron nail and electricity flows through the wire, the device becomes an electromagnet. Besides being able to act like an ordinary magnet, an electromagnet has two important advantages. Those advantages are that an electromagnet's power may be increased or decreased and that its power can be turned on or off at will.

In a doorbell, an electromagnet is usually used to pull a metal clapper repeatedly against a bell. In electric motors, an electromagnet may be used to continually repel a second magnet, producing a spinning motion. Attachments to the spinning part may be used to drive hand mixers, can openers and many other practical devices.

Perhaps the most useful application of the electromagnet is found in the telephone. When people speak into the transmitter, a thin metal plate vibrates against tiny carbon granules next to the plate. The granules are wired to conduct electricity. Sound vibrations from the voice squeeze the granules in variable ways. Loud sounds, for example, squeeze the granules more tightly than soft sounds do. So electrical impulses of varying strength, rather than a steady electric current, are produced and conducted. The impulses arrive at the other telephone almost instantly. There, the varying current causes an electromagnet to pull variably at a thin metal plate in the receiver. The plate sets off sound vibrations, and sound is heard.

Radio and television are also made possible because of electricity. At a radio station, music and voice vibrations are changed into radio waves. The waves are transmitted outward in all directions from a radio tower. The radio waves then travel through the air and strike the antenna of a person's radio. The radio waves are then picked up by the radio and changed back into music and voice vibrations, which a person hears.

TEACHING STRATEGIES

The purpose of the following activities and teaching strategies is to provide you, the teacher, with a wide variety of suggestions that can be used, together with

the material presented in the textbook, to help develop the processes and concepts of this unit.

Chapter 1: All charged up!, pages 98-105

— Pages 98-100, Static charges, can be read and discussed. You can write the following question on the chalkboard: "If lightning is a form of static electricity and we can make static electricity, why can't we use it?" To supplement the students answers, you can add that scientists have learned how to make powerful flashes and how to ground electrical lightning flashes with lightning rods. However, scientists have not been able to trap static electricity safely, store it and use it when they wish.

— Students should conclude that static electricity is caused by rubbing. You can explain that lightning too is caused by rubbing. A rain cloud has millions of drops of water. Small drops at the top of the cloud rub against air and get an electrical charge. Larger drops at the bottom of the cloud also rub against the air, but they pick up a different kind of charge. Then a huge spark jumps between the smaller drops at the top of the cloud and the larger drops at the bottom of the cloud. This is a flash of lightning.

— You can have students explore static electricity on their own by doing research and reporting on the experiences of Benjamin Franklin with static electricity.

— For the "Finding Out" on page 100, you may wish to use the worksheet found on page 18 of the activity book.

— After you have done the "Finding Out" on page 100, you can use "Activity Card 1, Static Electricity," to practise making predictions and to practise keeping a record of results.

— Pages 101 to 103, Moving Charges, can be read and discussed.

— After you have done the "Finding Out" (page 102) you may wish to explain to the students that the lemon acts as a single cell. When more than one cell is connected in a circuit, the cells become a battery.

— The dry cell battery will be studied in the sixth grade. However, you may find it useful to have groups of your students examine a dry cell as directed on "Activity Card 2, Examining a Dry Cell". Live cells will be needed for the first part of the investigation. A few live cells could be taken apart and tested with a light bulb. Have the students try to determine at what stage the bulb stops lighting. Other dry cells could be cut in half lengthwise and examined. Dead cells could be used for this examination. **DO NOT open alkaline cells**. The solution inside is dangerous to handle. Caution your students **not** to open batteries from automobiles or any lead-acid batteries.

— Pages 103 to 105, From power plants, can be read and discussed.

— To help your students to understand how a turbine makes an electric generator work, you can have them do the investigations on "Worksheet 2: How a turbine works".

— When the students have completed the investigation you may wish to point out that in earlier times, man used water power directly from a stream to power machines such as mills for grinding grain or sawing lumber. The water wheels were also used to do such things as pump water or weave cloth. The work had to be done near the water. Today the turbine has a shaft which turns a large electric generator which produces electricity. The electricity flows through wires which carry the electricity to towns and cities where factories are located.

— Please be sure to point out to your students that water power is only one source of electrical power. Page 105 identifies other sources such as steam, burning fuels, atomic power and heated underground water.

Chapter 2: Pathways for electricity, pages 106-113

— Pages 106 to 108, Conductors and insulators, can be read and discussed.

— Prior to doing the "Finding Out" on page 107, you may wish to provide the students with more experience with one dry cell and one bulb. For "Activity Card 3, Will the Bulb Light?", students will be predicting when the bulb will light. Discuss with the students why the bulbs in pictures 1, 2, 4, 10 and 12 will light up, whereas the bulbs in pictures 3, 5, 6, 7, 8, 9 and 11 will not.

— Students may work in groups to reduce the number of materials required.

— A worksheet for the "Finding Out" on page 107, is provided in the activity book (page 20).

— Page 108 can be read and discussed. In addition to making posters to illustrate the five safety suggestions given by "Safety Sam", you may wish to have some of your students try to complete "Worksheet 3, Using Electricity Safely". Information provided by electric power companies may be helpful for completing Worksheet 3.

— "Activity Card 4, Circuits" will provide students with experience working with circuits and with a system of notation for recording their results.

— Pages 109 and 110, One pathway, can be read and discussed.

— You may find it helpful to explain to your students that in a series circuit the whole current passes through each part of a circuit before going on to the next part. Therefore, one bulb gets all the current from two or more batteries. It also explains why loosening one bulb in a series of bulbs interrupts the flow of current.

— As the students do the "Finding Out" on page 110, you may wish to have them record their findings in the activity book (page 21).

— Pages 111 and 113, Many pathways, can be read and discussed.

— The parallel circuit illustrated on page 111 could be tried by the students so that they have a better grasp of electrical circuits.
— A worksheet for the "Finding Out" on page 113 is found in the activity book (page 22).
— You may wish to challenge some of your students by having them make "A Model of a Street Lighting System" from Activity Card 5. Using dowels for utility poles will provide more realism. Some of your students may wish to light a model building, a model town or a model airport. Some of the models could include student-made electric switches similar to those described in the "Finding Out" on page 116.

Chapter 3: Controlling and measuring electricity, pages 114-125

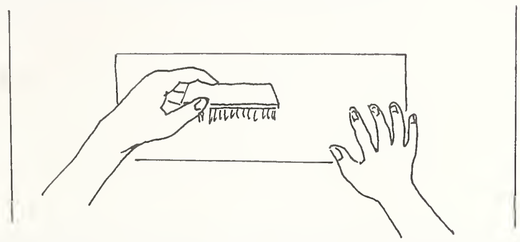
— Pages 114-120, Which switch? can be read and discussed.
— As your students do the "Finding Out" on page 116 you may wish to have them record their results in the activity book (page 23).
— Worksheet 4 provides your students with an opportunity to list examples of switches used by different kinds of appliances.
— You may wish to have some of your students do research to consider switches that are less familiar to them such as: photoelectric cell, rotary switch and mercury switch.
— Some of your students may wish to make an automatic switch similar to the one described on "Activity Card 6, An Automatic Light Switch".
— The "Finding Out" on page 120 can be done and the results recorded in the activity book (page 24).
— Pages 120 to 123, Whose fuse?, can be read and discussed.
— Page 25 of the activity book can be used to record the results from the "Finding Out" on page 122.
— A display of fuses with different ampere ratings can be set up in the classroom. Include blown fuses in the display so that students can make a comparison between fuse wires which are intact and those which are broken. Keep this display to form part of a larger display later.
— Circuit breakers and fuse boxes used in the school can be viewed and discussed.
— Pages 124 and 125, Watts up, can be read and discussed.
— A culminating activity for this chapter could be a display featuring a variety of different switches, light bulbs, fuses, circuits and dry cells.
— You may wish to include pictures of batteries such as those used in automobiles in your display.
— Both new and burned-out light bulbs and fuses can be displayed.

Chapter 4: How does electricity help you?, pages 126-139

— Pages 126-129 can be read and discussed.
— You may wish to have samples of different bulbs varying from 1.5 volt flashlight bulbs to regular household bulbs available for examination. If possible, try to get clear household bulbs which permit students to view the filament.
— Prior to doing the "Finding Out" on page 129, you may wish to have the students do "Worksheet 5, What's Inside a Bulb? Try to provide students with both flashlight bulbs and household bulbs. Break the glass on a household bulb by putting it into a paper bag and tapping it sharply with a hammer or similar object. Use a wirestripper and file to remove any jagged pieces of glass. Part of the base of some bulbs may be removed to provide a clearer view of the interior. Be sure that the students understand that the wires in the bulb form part of a continuous circuit.
— You can use page 26 in the activity book to record results from the "Finding Out" on page 129.
— Pages 130 to 133 can be read and discussed.
— The "Finding Out" on page 130 can be done by different groups of students with each group using a different number of turns of wire around the nail. The differences in the number of turns of wire could be in multiples of ten.
— The results of the "Finding Out" on page 130 can be recorded on page 27 of the activity book.
— Some students may wish to do research on what determines the strength of an electromagnet. They should find that the strength of an electromagnet depends on the shape, size and quality of iron in the core; on the number of turns of wire wound around each core; and on the strength of the electric current flowing through the wire.
— If electric doorbells are available, groups of students may wish to try to operate them. Ask the students to try to trace the path of the current from the switch through to the electromagnets.
— Many students will find that instead of door bells, their homes have door chimes. Most chimes differ from door bells in that they use a solenoid, which is another kind of electromagnet. You may wish to have some students do research to find out how a solenoid differs from a regular electromagnet. They should find that a regular electromagnet has a core *inside* made of iron around which wire is wound in a coil. In a solenoid, the core is *outside* of the coil of wire and is pulled into the coil when current passes through the coil.
— Pages 134 and 135 can be read and discussed.
— If you live near a newspaper with modern electronic equipment you may wish to arrange a visit so that your pupils can view modern communication equipment.
— Page 136 can be read and discussed.
— A simplified example of a telephone can be built. See "Activity Card 7, A String Telephone".
— Pages 137 to 140 can be read and discussed.

STATIC ELECTRICITY

You will need: a chalkboard
several sheets of paper
a piece of silk cloth
a piece of wool cloth
a piece of cotton cloth
a piece of nylon cloth
a leather glove
a stopwatch or a watch with a second hand



- Place a sheet of paper against a chalkboard and rub it rapidly with a brush. Does the paper cling to the chalkboard?
- Test to see whether the force with which the paper clings to the chalkboard depends upon the amount of charge given the paper.
- Try rubbing one sheet 5 times, another 10 times, a third sheet 15 times and so on to see if there is a difference in the length of time each sheet clings to the chalkboard.
- Before you begin, try to predict which sheet will cling the longest.
- Use the chart below to record your findings.

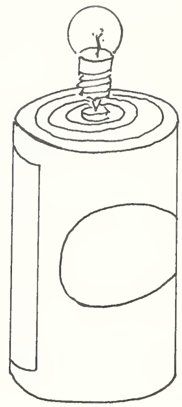
PAPER RUBBED BY	TIME PAPER CLINGS			
	5 STROKES	10 STROKES	15 STROKES	20 STROKES
SILK CLOTH				
WOOL CLOTH				
NYLON CLOTH				
OTHER PAPER				
LEATHER GLOVE				

You may wish to repeat the investigation using sheets of plastic instead of sheets of paper.

Electricity on the Move, Activity Card 1

EXAMINING A DRY CELL

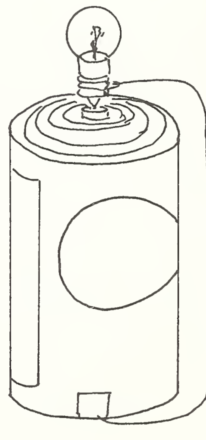
You will need:
- 1 D cell (live)
- 1 D cell (used up)
- 20 cm bell wire
- 1 flashlight bulb
- 1 wirestripper
- 1 hacksaw (optional)
- masking tape
- newspapers



- Place the bottom of the flashlight bulb on the top terminal at the centre of the dry cell.
- What happens?

- Strip the ends of the bell wire so that one end may be attached to the flashlight bulb and the other end may be used to touch the bottom of the dry cell.
- Tape one end of the bell wire to the bottom, metal end of the dry cell and wind the other end of the copper wire around the base of the bulb. Touch the bulb to the top of the dry cell.

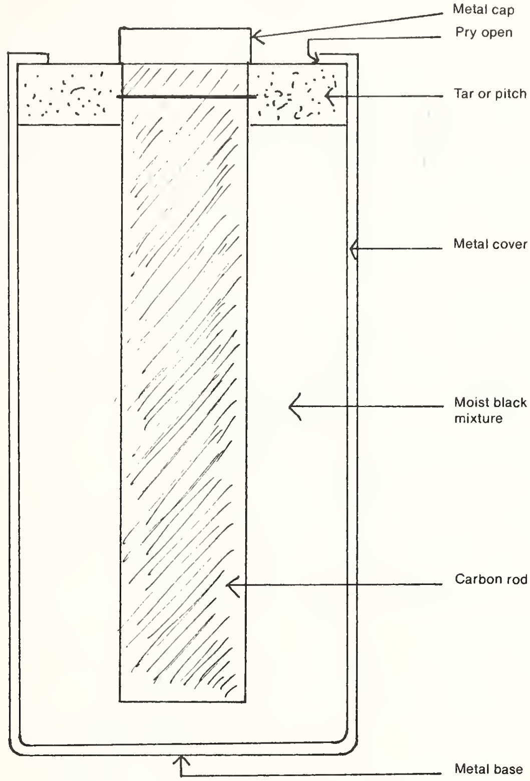
  What happens? Why?



What's inside a dry cell?
- Use the wire stripper and carefully remove the covering of the dry cell.
- Keep testing the dry cell's ability to light up a bulb as you take the dry cell apart.
- After the covering has been removed, can you light up a bulb by touching the side of the dry cell with an end of the wire?
- Use Worksheet 1, Inside a Dry Cell to help you to identify the parts of a dry cell.

INSIDE A DRY CELL

Most dry cells have parts like those shown in the diagram. As you take apart a dry cell (see Activity Card 2), you may use the diagram below to help you find the parts.



- Does the carbon rod touch the bottom of the battery case?

- Will a bulb light if it does?

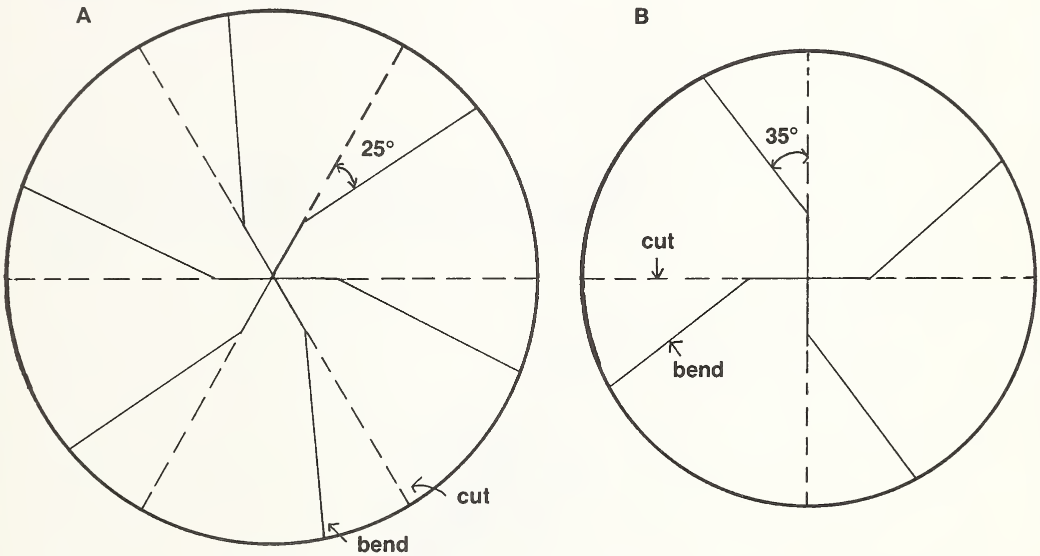
- Was the black material inside the dry cell "dry"?

HOW A TURBINE WORKS

You will need: 1 side of a milk carton
scissors
1 knitting needle or your pencil sharpened at both ends

string, 30 cm
tape

- If you have a two litre milk carton, follow the directions in part A. For a one litre milk carton use part B.
- Attach the circle with glue to a side of a two litre milk carton. Cut along dotted lines and bend along the short solid lines.



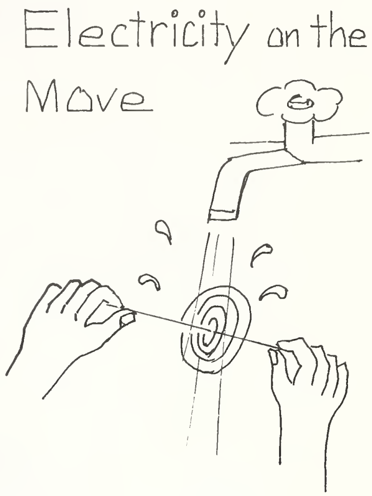
- Put the knitting needle through the centre of the circle. With each cut side bent, your circle resembles a pinwheel, a water wheel, a windmill, or a turbine.
- Hold your knitting needle on your fingers and blow on your "windmill".
- Do the blades whirl?

- How is your "windmill" like a real one?

- How is your "windmill" different?

Electricity on the Move, Worksheet 2

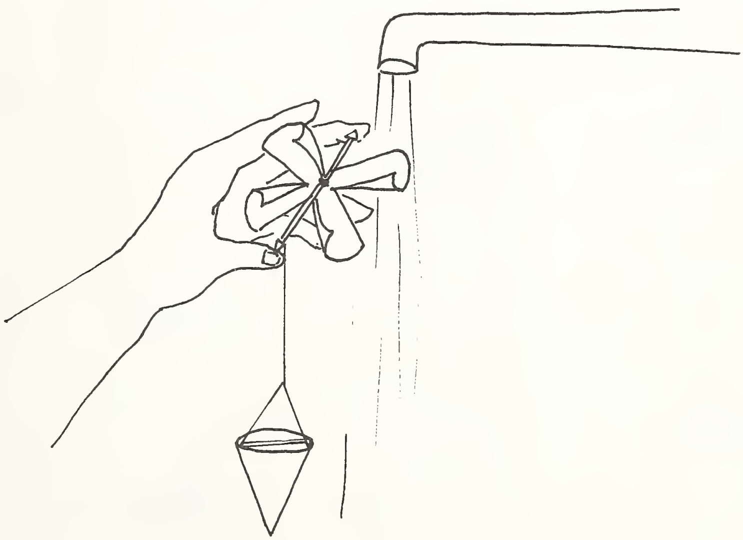
- Again hold your knitting needle on your fingers and hold the blades of your "turbine" or "water wheel" under a stream of water coming from a tap or poured from a pitcher.
- Do the blades whirl?



- How is your "turbine" like a real one used in an electric generator?

- How is your "turbine" different?

- You may wish to show how your "water wheel" can do work. To do this, tie a string around a small object such as a small eraser and tape the other end of the string to the knitting needle.



- Hold the "water wheel" in a stream of water. As the knitting needle turns the string will wind up lifting the small object.

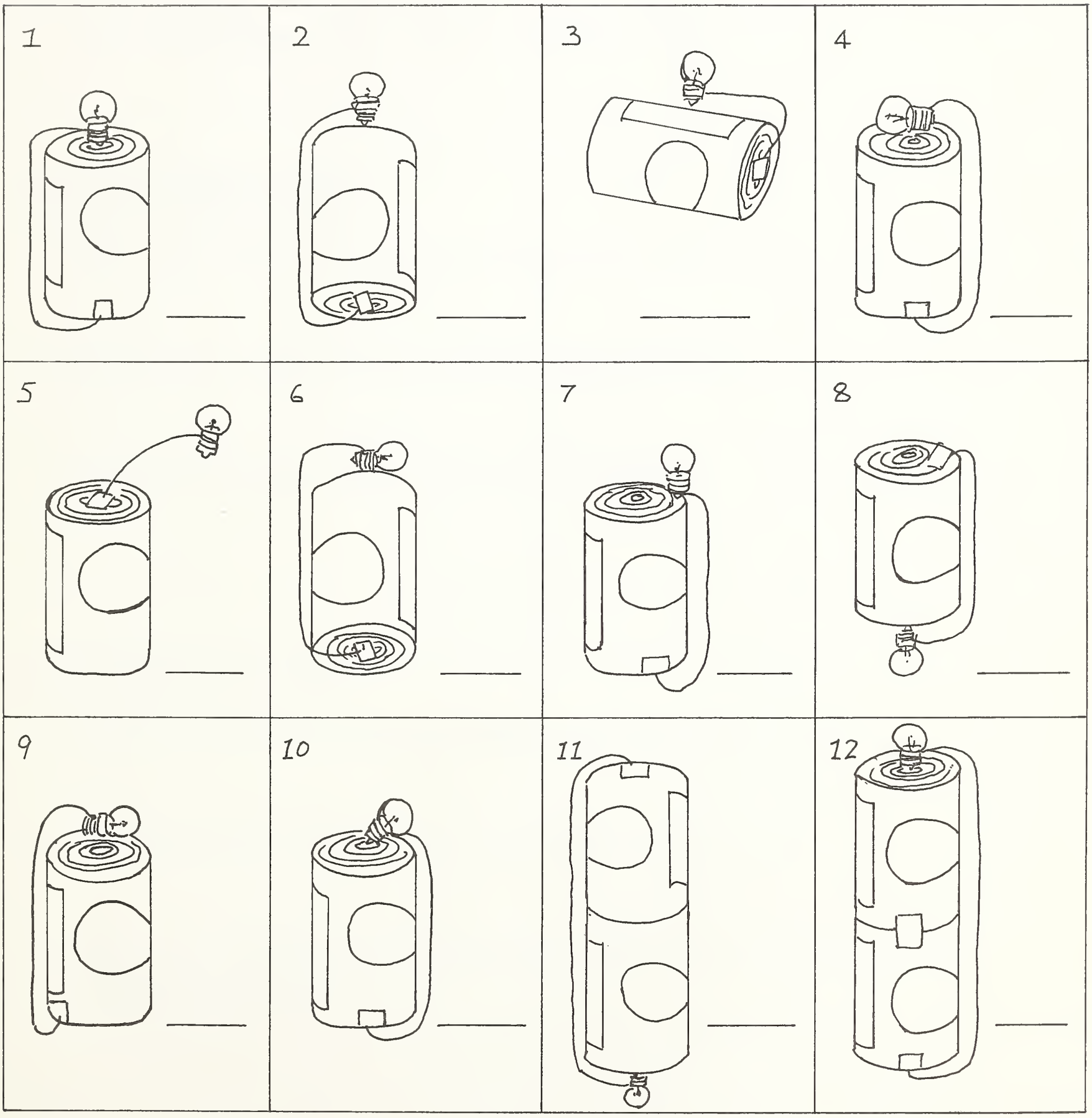
Electricity on the Move, Worksheet 2 (continued)

WILL THE BULB LIGHT?

You will need: 2 D cells (live)
1 flashlight bulb
20 cm bell wire

1 wire stripper
masking tape

- Examine each picture below and try to predict whether or not the bulb will light up.
- On the space provided beside each picture, write yes if you predict that it will light up and no if you think it will not light up.
- For investigations 11 and 12 tape one D cell to another D cell.



USING ELECTRICITY SAFELY

Try to complete or add to the list of safety precautions:

A. Safe Use of Appliances

1. Keep your hands away from the inside of a radio or television set because

   ____

2. Turn off the switch of an appliance before connecting it and disconnecting it. If it is still connected, you may ____________________

   ____

3. Disconnect all appliances such as toasters, irons, soldering irons or heating pads when they are not in use. Leaving them on may ____________

4. ____

   ____

B. Safe Use of Electrical Cords

1. Never use a worn or frayed cord. Using such a cord may ____________

   ____

2. Christmas tree lights whose wires are cracked should ____________

   ____

3. A light that flashes when it is turned on should ____________

   ____

4. ____

   ____

C. Safety Around Power Lines

1. If a kite or model airplane gets caught in a power line, ____________

   ____

2. Wires have fallen during a storm. You should ____________

   ____

3. When a fuse is blown it should be thrown away. You should never try to repair a broken fuse because ____________

   ____

4. ____

   ____

USING ELECTRICITY SAFELY
(sample answers)

A. Safe Use of Appliances

1. Keep your hands away from the inside of a radio or television set because there may be extremely high voltage on some of the wires.
2. Turn off the switch of an appliance before connecting it and disconnecting it. If it is still connected you may injure yourself or damage the appliance.
3. Disconnect all appliances such as toasters, irons, soldering irons or heating pads when they are not in use. Leaving them on may cause a fire to start.
4. Connect or use an appliance or electrical tool only if you know how to operate it.

B. Safe Use of Electrical Cords and Switches

1. Never use a worn or frayed cord. Using such a cord may give you a shock.
2. Christmas tree lights whose wires are cracked should not be used.
3. A light that flashes when it is turned on should be repaired or replaced immediately. Check the light switch too.
4. Never touch a light switch when you are wet.

C. Safety Around Power Lines

1. If a kite or model airplane gets caught in a power line, call the power company to get it down.
2. Wires have fallen during a storm. You should keep away from the wires and notify the power company.
3. When a fuse is blown it should be thrown away. You should never try to repair a broken fuse because you are not likely to be able to make the fuse safe enough to protect you.
4. Do not play with kites or model airplanes new power lines.

Electricity on the Move, Worksheet 3 (continued)

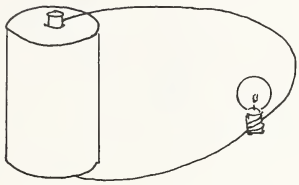
CIRCUITS

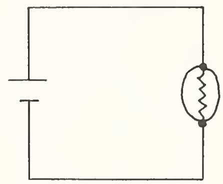
You will need: 4 pieces of #20 bare copper wire (15 cm each)
2 flashlight bulbs and holders
2 D batteries
masking tape

- Learn to use the following symbols to make drawings of your circuits:

Battery Top | All wire | Bulb | Wires joined | Wires crossed

Bottom

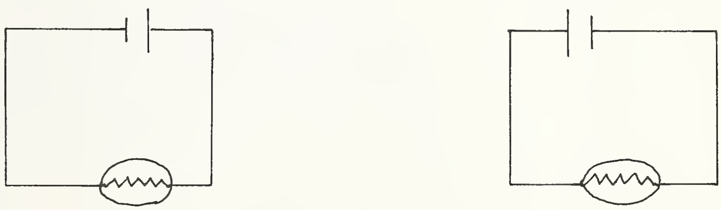




but not joined

- Please note that the symbol for the battery shows the way it is facing.
- Try to predict what will happen if you make the circuits shown below. Then make the circuits.

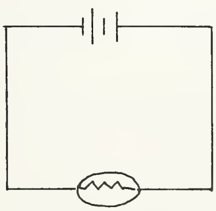
1



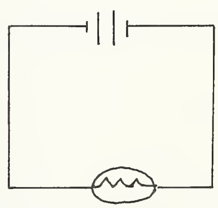
- Predict the results of these circuits. Then try to construct them.

2

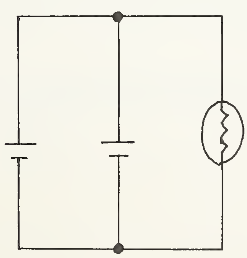
A



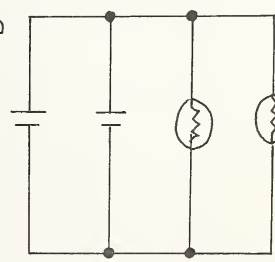
B



C

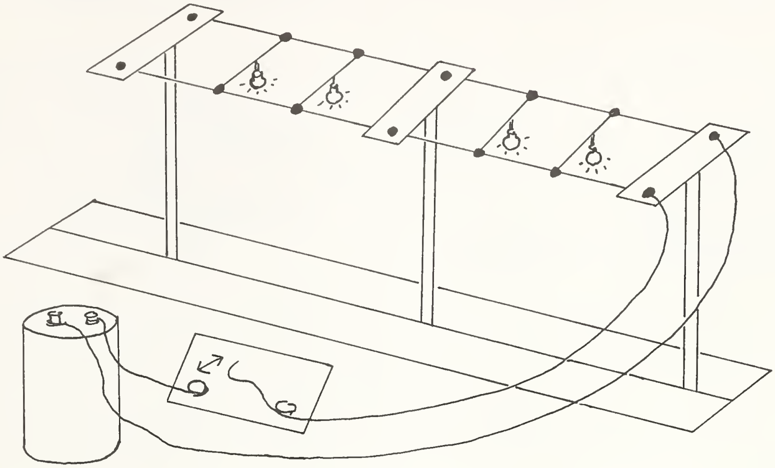


D



Electricity on the Move, Activity Card 4

MAKING A MODEL STREET LIGHTING SYSTEM



You will need: 1 dry cell with posts (1.5 volts)
simple electric switch
electrician's tape
bell wire
4 bulbs (1.5 volt) and sockets for them
3 thin strips of wood (1 cm x 8 cm x 0.5 cm)
3 thin strips of wood (1 cm x 12 cm x 0.5 cm)
1 thin piece of wood (10 cm x 40 cm x 0.5 cm)
6 wood screws (1 cm)
short nails (about 2 cm)

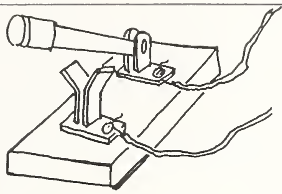
- Follow the diagram.
- Put a screw near each end of the shortest strips of wood.
- Attach each short strip to the medium strips (12 cm long) to form a T and attach each T to the larger wood piece.
- String each with bell wire making sure to bare the wires.
- Connect them to the screws and back to the dry cell or the switch.
- Use short pieces of bell wire attached to the light bulbs. Remove the insulation from the main lines and attach the short wires with the bulbs. Use tape to hold the connections in place.
- When your model system is complete, throw the switch. Try removing a bulb or two.
- What happens? Why?

Electricity on the Move, Activity Card 5

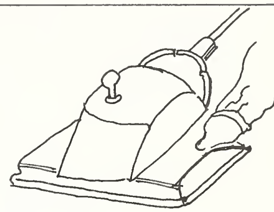
KINDS OF SWITCHES

Try to list the names of as many appliances as you can that use each type of switch:

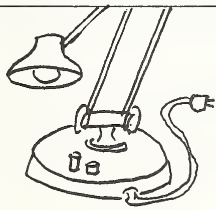
knife switch



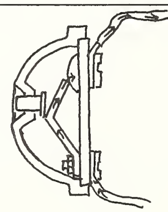
flip switch



push button switch

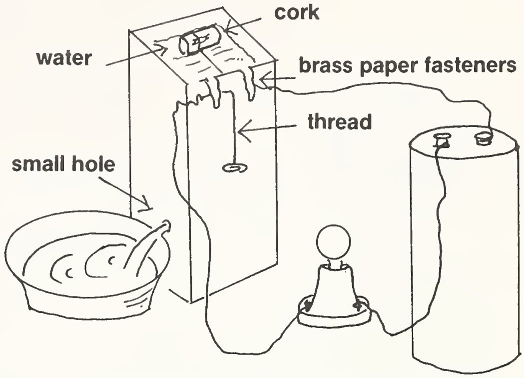


bell switch



AN AUTOMATIC LIGHT SWITCH

You will need: a 1 L milk carton
1 shallow dish that will hold 1 L of water
1 paper clip
2 brass paper fasteners
1 dry cell (1.5 volt)
1 light bulb and socket
bell wire
1 cork or small piece of wood
thread
water (1 L)



- Use the diagram above to guide you.
- Be sure your thread is of a length that will permit the paper clip to touch the brass fasteners when the water level has nearly been lowered to the level of the drain hole.
- Why will the bulb not light up when the milk carton is full of water?
- Why will the light bulb glow when most of the water has been drained from the carton?

Electricity on the Move, Activity Card 6

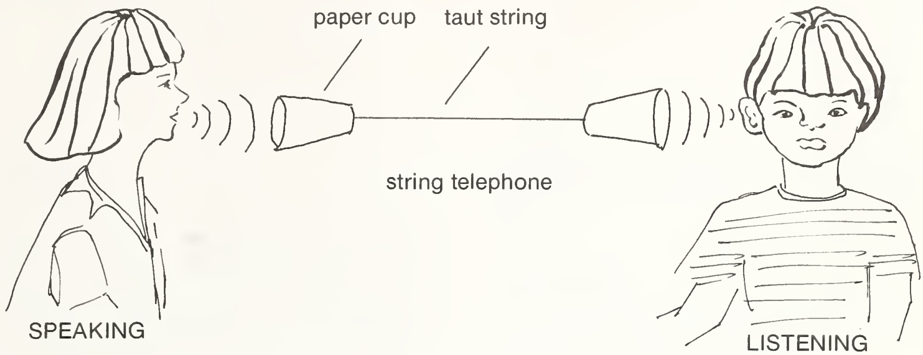
WHAT'S INSIDE A BULB?

- Your teacher will provide you with samples of bulbs.
- First make drawing of a bulb that is in good working order. Beside that picture make a drawing of a bulb whose glass has been removed.

Electricity on the Move, Worksheet 5

A STRING TELEPHONE

You will need: 2 paper cups or two metal cans
7 m of string



- Make a hole in each container large enough for the string to pass.
- Put the string through the bottom of each container and tie a knot.
- Hold the containers apart with the string taut. Speak into one container while a friend listens with the other.
- How does the sound travel from one "telephone" to the other?

- See if you can find out how your telephone differs from a regular telephone.

Electricity on the Move, Activity Card 7

GREEN BOOK (5)

Unit 4: Light

Pages 144-191

UNIT OVERVIEW

Concept Development

In the preceding levels of the program, the following concepts were introduced and developed:

There are many sources of light. Some of these are natural and others are artificial. Solar, thermal, chemical and electrical light are some of the more familiar light sources. In order to see an object, a light source is necessary. A light source is also necessary to form a shadow.

In this unit, students explore some of the properties of light and colour. They also consider how light allows us the use of our most important sense — sight.

Unit 4 "Light" consists of three chapters. Chapter one explains how light travels. Also discussed is what happens to light when it travels to opaque, transparent or translucent things. Chapter two examines light and colour. The importance of vision and the process of seeing are explored in the third chapter.

Process Development

Activities with light provide a good way to develop an understanding of *cause and effect relationships*. For example, when a mirror is rotated, the reflection also rotates.

In *observing* and *comparing* cause and effect relationships, students use *qualitative* and *quantitative* descriptions. Students can describe objects and events in terms of their qualities, such as colour, shape, movement, size and position. Those observations, however, become much more significant and useful when they are expressed in quantitative terms by applying a standard of measure to them.

In the "Finding Out" activities, students first *investigate* how light travels, and what effect transparent objects (page 151) and opaque objects (pages 155 and 157) have on the path of light. They then construct a simple water drop lens, and from their observations make *inferences* on how lenses bend light rays (page 152).

In the "Finding Outs" on pages 161, 163 and 167, students *investigate* the colour spectrum and how light and pigments give things colour. A number of activities on seeing are then undertaken. Students start by *making a model* to *demonstrate* how an image is formed on the retina of the eye (page 171). Peripheral vision is then *investigated* (page 173). This is followed by an activity on image retention (page 176), and the unit ends with an investigation of an optical illusion. (page 181).

Related Units

Light and Shadows *Orange Book (1)*
Interacting with your Environment *Red Book (6)*
Changes in Energy *Red Book (6)*
Science: Something People Do *Exploring Matter and Energy (7)*

Materials and Advance Planning

The following list includes the materials that a student, or in some cases a group of students, will need to carry out the activities in this unit. In some instances, other materials may be substituted for those on the list.

Pencil; drinking glass; thin piece of wire; large nail; newspaper; small, flat mirror; comb; flashlight; cardboard; 2 large, flat mirrors; tape; white paper; objects with a variety of colours, such as clothes, books, marbles and coloured paper; incandescent lamp; fluorescent lamp; piece of green, red or blue cellophane; round cereal box; scissors; tissue paper; tinfoil; candle with holder; pin; string; piece of chalk; ruler.

The additional activities suggested in the resource guide require: modeling clay; 4 pieces of cardboard (25 cm square); shoebox; clear glass; food wrap; wax paper; frosted glass; silk (nylon) scarf; piece of wood; a penny; round-headed bolt (2 cm) and a nut; several sheets of construction paper; convex lens (magnifying glass); geometric compass and triangle.

BACKGROUND INFORMATION

Chapter 1: Pathways of light, pages 146-157

Whether light comes from the sun or from artificial sources, light travels faster than anything else people know. Light travels at about 300 000 km/s. This is why an event on the earth is seen at virtually the same time the event happens. Light typically travels in straight lines. Therefore, when light strikes an opaque object, or an object through which light cannot travel, that object blocks part of the light. The light that is not blocked forms an outline of the shape of the opaque object, which people recognize as a shadow.

Objects such as thin paper and frosted glass permit some light to pass through. Objects that allow some light to pass through are called translucent.

When light penetrates a translucent object, the light scatters in many directions. Early pioneers often covered window areas with paper to permit some light to enter their log cabins. Oil was usually smeared onto the paper for waterproofing and for increasing the amount of light passing through.

Transparent objects such as windowpane glass and air permit light to pass through with little scattering, or distortion. However, the speed of light changes as it travels through transparent objects of different densities. That is, light travels at a different speed when traveling through air than it does when traveling through water.

It is because of these differences in speed that a light beam entering or leaving a different medium at a slant will be bent, or changed in direction. For example, a pencil half submerged in water looks "bent." The bending of light is called refraction.

The use of refraction is common in the lenses of eyeglasses, telescopes, microscopes and binoculars. For example, an object viewed through a curved lens will appear larger if the lens is thicker in the middle than at the edge. An object will appear smaller if viewed through a lens that is thinner in the middle than at the edge.

The pathways of light can be altered not only by scattering and by bending but also by bouncing. For example, if a person throws a ball against a smooth pavement, the ball bounces back in a straight line. But if the ball is bounced against rough gravel, the ball's return path would be unpredictable. Similarly, a rough or an uneven reflecting surface affects the direction light bounces off that surface. As a result, a smooth reflecting surface such as a mirror reflects light in a predictable way, whereas a rough surface reflects light in an unpredictable way.

Chapter 2: Colour, pages 158-167

Sir Isaac Newton performed experiments with prisms and sunlight, which led to an understanding of colour. Newton placed a glass prism so that a beam of sunlight would pass through the prism. Newton discovered that the prism broke up the beam of sunlight into seven colours — red, orange, yellow, green, blue, indigo and violet. This group of seven colours is called a spectrum.

A person sees a certain colour because all the colours in the spectrum except for that particular colour are absorbed, leaving only that colour to be reflected back to the person. For example, a red apple looks red when struck by sunlight. The reason for this is that all the colours in the spectrum are absorbed by the skin of the apple except for red. Only red is reflected to a person's eyes. A white object looks white because it reflects virtually all the light that strikes it. Little or no light energy is absorbed. A black object absorbs virtually all the light that strikes it. Little, if any, light is reflected.

It is difficult to duplicate the exact colours of sunlight with artificial lighting. So people can never be sure, for example, of the exact colour of clothing they buy if they are using artificial light to judge the colour. The reason the exact colour of something is especially hard to determine when artificial light is used is that incandescent bulbs usually are deficient in blue. Fluorescent bulbs usually contain more blue than sunlight. Therefore trying to match colours of clothing under such lighting conditions can be extremely difficult.

There are two basic ways to mix colours. One way is with coloured beams of light, and the other way is with paints. With overlapping light beams of three pure primary colours — red, blue, and green — white light is made. The three primary colours of paints are red, yellow and blue. When mixed, these paints absorb practically all the white light that strikes the mixture of paint, causing that mixture to look black.

By mixing the three primary colours of light or those of paint in varying amounts, all the other colours in the spectrum can be made.

Chapter 3: Seeing is more than looking, pages 168-187

The front portion of the eye is covered with a transparent covering called the cornea. The cornea permits light to pass into the eye. Behind the cornea is a dark opening called the pupil. This opening is regulated by muscles that make up the iris, or the coloured portion of the eye. In dim light, the iris tightens, causing the pupil to enlarge. This enlargement allfows additional light to enter the eye, thus helping a person to see better in dim light. In bright light, the iris relaxes, causing the size of the pupil to become very small. This decrease in the amount of light entering the eye enables a person to see when the light is very bright.

Just behind the pupil is the crystalline lens. Attached to the crystalline lens is a muscle that can change the shape of the crystalline lens. When a person looks at a close-up object, the muscle tightens, causing an increase in the bend of the lens. This bend, in turn, bends the light rays passing through the lens and focuses those rays onto the back wall of the eye, where nerve cells sensitive to light are found. This area at the back of the eye is called the retina, and light rays must be focused on the retina in order for normal vision to occur.

When people look at an object that is far away, the muscle controlling the lens is relaxed, resulting in only a slight curve in the lens. However, that curve is sufficient to focus the light rays onto the retina.

The retina, which contains many tiny nerve endings, is connected to an optic nerve. As light rays strike the retina, the nerve cells making up the retina change those rays into electrical impulses. These impulses then travel along the optic nerve to the brain. Once the impulses reach the brain and are interpreted by the brain, people actually see what they are looking at.

Having two eyes to see with enables a person to judge distance. Each eye sees an object from a slightly different angle. The closer an object is to a person, the more different the image of the object will appear to each eye. The farther an object is from a person, the more alike the image of the object will appear to each eye. Differnces in the image seen are, of course, interpreted by the brain.

Persistence of vision, or the after-image effect, occurs quite often. For example, after staring at a strong light for a brief period, a bright image may appear for a while even after the person is looking at another object. Also when people stare at a bright colour, the portion of the retina sensitive to that colour seems to tire. If the person then looks at a white surface, the person may see a complementary colour appear.

Some people have problems with seeing. One of these problems is nearsightedness, or myopia.

The nearsighted eye often is slightly longer than normal. This causes the light rays bouncing from an image to focus short of the retina. A concave eyeglass lens bends the light rays less sharply, thus correcting the problem of nearsightedness.

Another problem with seeing is farsightedness, or hyperopia. The farsighted eye is often shorter than normal, thus preventing images from being focused on the retina. A convex eyeglass lens bends incoming light rays more sharply, thus correcting the problem of farsightedness.

Many vision problems cannot be prevented, even though they usually can be corrected. However, some vision problems can be prevented. For example, having regular checkups, never rubbing the eyes, and using good lighting when reading and studying are some ways to help prevent eye problems. Being alert to signs of eyestrain or poor vision and getting professional help when needed can also be helpful.

TEACHING STRATEGIES

The purpose of the following activities and teaching strategies is to provide you, the teacher, with a wide variety of suggestions that can be used, together with the material presented in the textbook, to help develop the processes and concepts of this unit.

Chapter 1: Pathways of light, pages 146-157

— Pages 144 and 145 can be read and discussed.

— You may wish to have the students discover that the fabrics arranged in the shape of a rainbow actually have seven basic colours. Your students should identify them as red, orange, yellow, green, blue, indigo and violet. You may need to supply the names indigo and violet. Have the students take the first letter of each colour in order beginning with red and try to make a boy's name. They may make the name ROY G. BIV. If they remember this name they will have the order and names of the colours of the rainbow in the spectrum of light.

— Use a mirror to decipher the message on page 145. Students may enjoy writing their own short inverted message for others to decipher. Have everyone use block letters. You may wish to provide an additional example for the students to try such as:

:TI SI SIHT

— Pages 146 and 147, Travelling fast, can be read and discussed.

— You may wish to have the pupils look in reference books to find out the speed of light. To help your pupils understand how fast light travels, have them think of how far they could travel in one hundredth of a second if they were travelling at the speed of light (300 000 km $\div$ 100 = 3 000 km). If they travelled $^{1}/_{100}$ s from home at this speed, where would they be?

— Page 148, Making Shadows, can be read and discussed.

— You can have your pupils discover that some shadows are darker than others by using "Activity Card 1, Shadows". They should be able to determine that some of the light shines through the handkerchief but that no sunlight shines through the book.

— "Activity Card 2, How Light Travels" will help the pupils to understand that light travels in straight lines.

— Pages 149 and 151, Passing through things, can be read and discussed.

— A bulletin board display can be arranged showing transparent things, translucent things and opaque things.

— "Activity Card 3, Passing Through Things", will help the pupils to discover how transparent things, translucent things and opaque things differ from each other.

— As you do the "Finding Out" on page 151, you can record the results on page 28 of the activity book.

— "Activity Card 4, Bending Light" provides your pupils with an opportunity to see light bent twice — once when the light leaves the air and enters the water and again when light leaves the water to re-enter the air. In the second part of the investigation, light is bent or refracted more as the boy's eyes lower toward the edge of the cup until the surface of the water acts as a reflector.

— Pages 151 to 153 can be read and discussed.

— As your pupils do the "Finding Out" on page 152, they can record their findings on page 29 of the activity book.

— You may assist your pupils to expand their experiences with bent light and lenses by using bottles of different shapes filled with water. Include spherical and cylindrically shaped bottles. You may wish to have your pupils look at objects through the bottles and in the bottles.

— Pages 154 and 155, Bouncing Light, can be read and discussed.

— The results of the "Finding Out" on page 155 can be recorded on page 30 of the activity book.

— A demonstration first with a ball and later with a flashlight and a mirror will help your pupils understand how light bounces. You can start by bouncing a ball straight down and having the pupils note that the ball will bounce straight up. When you bounce the ball at a slant the ball will go off at a slant. You can follow this up by using a flashlight to cast a light on a mirror, first straight into the mirror and then at various slants. Placing the mirror flat on the floor may be the most effective position from which to see the angles of the reflected light. An actual demonstration should help to fix the rule that light is reflected at the same angle at which it strikes an object.
— You may wish to discuss how we use this knowledge of how light is reflected in our daily living. Students may identify reflectors on signposts or roadmarkers. They may also identify other reflectors such as rear view mirrors on automobiles and reflector lights or buttons on bicycles.
— Pages 156 and 157 can be read and discussed.
— Large mirrors are best for the "Finding Out" on page 157, however mirrors of the type found in a lady's handbag will work. As well as winking an eye you may wish to have your pupils place a pencil behind one ear and note where it appears on the mirror.
— If you still have the inverted messages from the first part of this chapter try reading them with the two mirrors. Also try reading a regularly printed page.

Chapter 2: Colour, pages 158-167

— Pages 158 to 162, Colour in light, can be read and discussed.
— If you identified the colours and their order at the beginning of chapter one, your students may remember that their order matches the name ROY G. BIV.
— The "Finding Out" on page 161 can be done and the results recorded on page 31 of the activity book.
— You may wish to try to make another spectrum by placing a large piece of white paper on the floor near a window that permits direct sunlight to enter. Place a full glass of water on the window sill so that part of the glass extends over the sill. If the sun is shining brightly you may get a spectrum on the paper.
— Pages 163 and 164, The colour of things in sunlight, can be read and discussed.
— "Worksheet 1, Which colours are reflected?" can be used to provide a better understanding of how colour is reflected.
— The "Exploring on Your Own" on page 164 can be effectively illustrated if you live in an area where there is snow. Lay two samples of light and dark cloth on the snow and observe the rate of melting under each sample. The snow under the dark cloth should melt faster than the snow under the light cloth.
— Page 165, The changing colour of the sky, can be read and discussed.
— You may wish to point out to your pupils that all colours turn blue if you look at them from a long way off. For example, if you look down a road it will look more and more blue as it runs away from you. Even trees and grass when viewed from a distance tend to look blue.
— "Activity Card 5, Colour Discs" can provide your pupils with an opportunity to see how colours blend. The two colours (blue and yellow) should blend together to form the colour green when the disc is spun. The three colours (red, blue and green) should blend together to form a grayish-white colour when the disc is spun.
— Pages 166 and 167, The colour of things in coloured light, can be read and discussed.
— The data from the "Finding Out" on page 167 can be recorded on page 33 of the activity book.

Chapter 3: Seeing is more than looking, pages 168-187

— Pages 168-171, Seeing the light, can be read and discussed.
— In addition to the activity described in the teacher's guide on page 169, you may wish to have your students work with partners to discover how the pupils of their eyes react to light. Have one partner close his eyes and cover them with his hands for one minute. At the end of one minute have him uncover his eyes and have his partner view and describe for him how his iris changes shape.
— You may wish to have your students do "Worksheet 2, The Eye" to practise identifying the parts of an eye.
— "Activity Card 6, How a Convex Lens Works" will provide your students with an understanding of how the convex lens in their eyes works. If a slide projector is available you can show the effects of putting the slide into the projector "upside down".
— When your students have done the "Finding Out" on page 171, the results can be recorded on page 34 of the activity book.
— Pages 171 and 173, Seeing with two eyes, can be read and discussed.
— You may wish to point out to your students that although we use two eyes for seeing, we can look at only one thing at a time. We normally shift our gaze from object to object very quickly thus permitting our eyes to "blend together" what we see and remember.
— Although two eyes are necessary in order to see things properly, we all have one eye that is dominant. This dominant eye takes over sight when we want to see things distinctly. You can have your students experience this phenomena by placing their thumb and index finger together to form a ring. Pick out an object that can be seen by looking through the "ring" with both eyes. While focusing on the object with both eyes, cover one eye and then the other while looking at the object. One eye will see the object perfectly but the other will not even seem to be looking near the object.

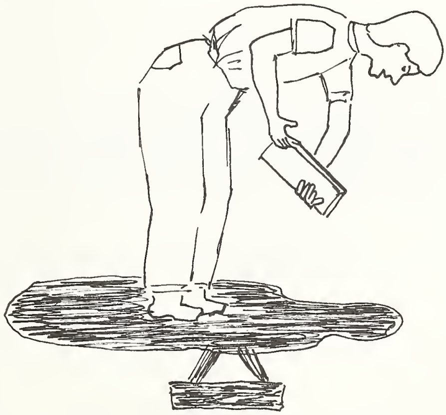
— Pages 174-177, Seeing through interesting things, can be read and discussed.
— "Activity Card 7, Making Colour" can be used to do the suggested activity in the teacher's guide (page 174). Have the students experiment by spinning the top at different speeds. When the students succeed in creating the illusion that there are six rings, have them slow down slightly and the rings will appear coloured. When you spin the top clockwise the outer rings will be blue and the inner rings will be red. Spinning the top counter clockwise will cause the colours to change places.
— When your students are doing the "Finding Out" on page 176, it may be helpful to have them begin by drawing a bird cage on one side of the cardboard and a bird on the opposite side. If they rub the pencil with the cardboard back and forth between the palms of their hands, the bird will appear to pop in and out of the cage.
— You may wish to have your students create their own optical illusions by using "Activity Card 8, Optical Illusions".
— Page 35 in the activity book may be used to record the observations made about the moon.
— Pages 181-184, Problems in seeing, can be read and discussed.
— "Activity Card 9, Astigmatism" can be used by your students to test themselves for astigmatism.
— To help your students understand how the lenses in their eyes behave, you may find it useful to refer to "Activity Card 6, How a Convex Lens Works". Your students found that a sharp picture was formed when they held the lens the right distance from the paper. If they moved the lens too close to the paper or too far from the paper, the picture became fuzzy. When the eyeball is a little too short from the lens to the retina, objects near the eye look fuzzy just as the picture does when the lens is too close to the paper. This is farsightedness. When the eyeball is too long from the lens to the retina, objects far away look fuzzy just as the picture does when the lens is too far from the paper. This is nearsightedness.
— The ways to take care of your eyes discussed on page 184 can be expanded in a class discussion. Additional ways to take care of the eyes could include:
  — Be careful when playing with sticks, toy guns and similar playthings.
  — Wear glasses if they have been prescribed by an eye doctor.
  — Avoid reading in a car or other moving vehicle. The reading material jiggles and moves with the vehicle. This movement causes your lens' muscle to work overtime.
— A large chart listing these and other rules could be prepared for the bulletin board.
— Pages 185-187, Some interesting eyes, can be read and discussed.
— You may wish to expand on the ideas provided in "Some Interesting Eyes" by asking the students to identify and compare animals that go to sleep soon after sunset with animals that move about at night. Chickens and most wild birds lack rods in their eyes and cannot see well in dim light. Horses, owls and members of the cat family have rods in their retinas which permit them to see well at night.
— You may wish to have some of your students find out more about this topic by doing research under the heading "Rods in Eyes." The topic could be expanded to include cones which control man's ability to see colour.
— If you are studying this unit when flowers are in bloom, you may wish to observe the colour of plants and their flowers as darkness approaches at the end of a day. At sunset, red will be the first colour to disappear. Blue and violet plants will look brighter than they did in bright sunlight. Green coloured plants will remain visible the longest.

SHADOWS

You will need: a sunny day
a handkerchief
a book

- Hold a handkerchief so that the sun shines on it. Notice the shadow on the ground made by the handkerchief.

- Hold a book so that the sun shines on it. Notice the shadow on the ground made by the book.



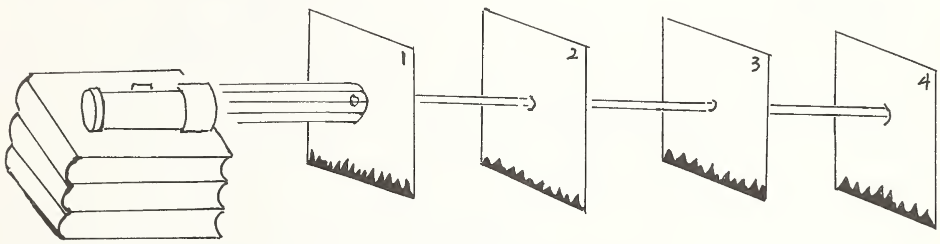
- Why is the shadow made by the book darker than the shadow made by the handkerchief?

- Did you know that night is a shadow? The sun shines on one side of the earth at a time leaving the other side in shadow. The shadow makes the night.

HOW LIGHT TRAVELS

You will need: a room that can be darkened
flashlight
modeling clay
4 pieces of cardboard, each 25 cm square

- Mark a hole at the centre in all but one of the pieces of cardboard. Your hole should be 5 mm in diameter.
- Set the pieces of cardboard in an upright position using the modeling clay to hold them in place.
- Arrange the flashlight on the books as shown in the diagram.



- Darken the room and turn on the flashlight so that the light passes through the holes in the first three pieces of cardboard and shines on the piece of cardboard without a hole.
- Try moving a piece of cardboard to the right or left. Try moving a different piece of cardboard.
- How does this show that light travels in a straight line?

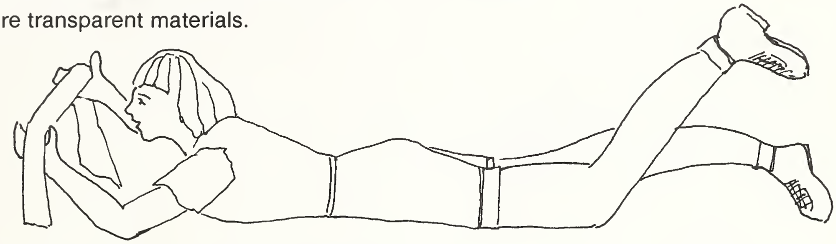
Light, Activity Card 2

PASSING THROUGH THINGS

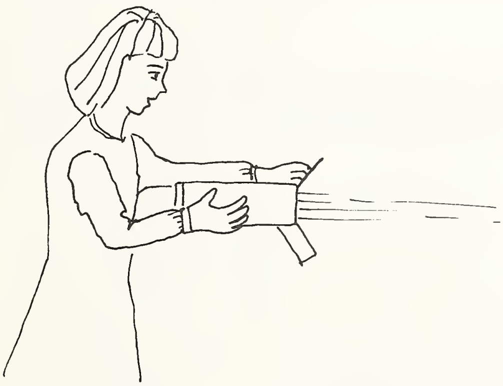
You will need:

- a room that can be darkened
- a shoe box
- a flashlight
- an elastic band
- clear glass
- clear food wrap
- wax paper
- frosted glass
- a silk or nylon scarf
- a piece of wood
- a book
- metal foil
- white paper

- Pick an object in the room that can be easily seen. A clock is a good object.
- Hold each piece of your test material above to your eye.
- Which materials permit you to see the clock or other objects?
- These are transparent materials.



- Cut a hole about 4 cm square in one end of the box.
- Turn on the flashlight and place it in the box. Darken the room.
- Hold each piece of test material over the hole in the box. All of the materials that you decided were transparent should permit you to see into the box easily.
- If the material only permits light to go through the material, it is translucent.
- If no light passes through the material, it is opaque.



- Now try shining the flashlight on each piece of material in the darkened room.
- All the materials that make a dark shadow are opaque.
- Do the transparent and translucent materials make shadows?

Light, Activity Card 3

BENDING LIGHT

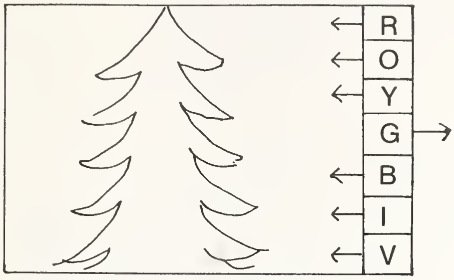
You will need: a penny
a cup or other opaque container
a small pitcher of water
a partner

- Stand as still as you can so that you can see the penny in the cup.
- Have your partner move the cup away from you very slowly until you are not able to see the penny anymore.
- Have your partner pour water into the cup.
- Can you see the penny? Why?

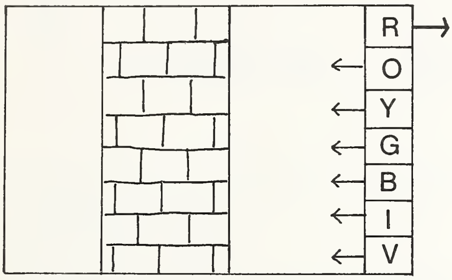
- Look at the penny in the cup with water. Bend your knees so that your head is lowered to a position where you are looking over the edge of the bowl. As you lower your head, the penny should appear to be climbing up the side of the cup until it disappears into the air.

- Why does the penny appear to move up the side of the cup?

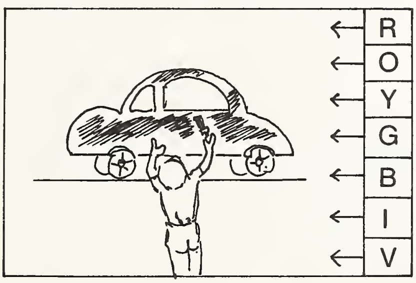
WHICH COLOURS ARE REFLECTED?



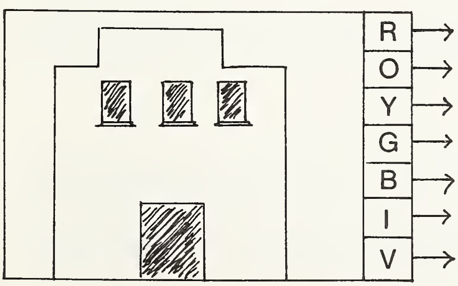
This diagram is intended to show that the tree's leaves absorb all of the colours of the spectrum but green. Colour the tree's leaves, the box with the G, and its arrow green to show that this is the colour reflected by the tree.



This diagram is intended to show that the chimney stack absorbs all colours of the spectrum but red. Colour the chimney stack, the box with the R, and its arrow red to show that this is the colour reflected by the chimney stack.



This diagram is intended to show that the car absorbs all the light from the spectrum. Colour the car black.

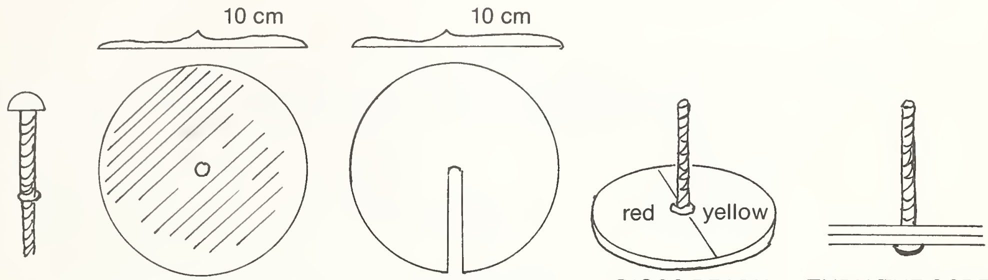


This diagram is intended to show that the white wall of the building reflects nearly all the colours of the spectrum. Colour the box with R and its arrow red. Colour the box with the O and its arrow orange and so on.

Light, Worksheet 1.

COLOUR DISCS

You will need: 1 round-headed machine bolt (2 cm) and nut
a piece of stiff cardboard about 10 cm square
several sheets of coloured construction paper including the colours red, green, blue and yellow
a compass
scissors



CARDBOARD BASE | COLOURED DISC | DISCS READY FOR SPINNING | TURN THE SCREW TO SPIN THE DISCS

- Use your compass to draw a circle with a 5 cm radius on the cardboard and the coloured construction paper.
- Cut out each circle.
- At the centre of the cardboard disc, make a hole the size of the machine screw's diameter and place this cardboard disc at the bottom of the shaft of the screw.
- At the centre of each disc of construction paper, make a hole like you did for the cardboard disc.
- Cut a slit in each disc made from construction paper. The slit should run from the centre to the edge of the disc.
- Place the blue disc on the shaft of the screw. Place the yellow disc over the blue disc so that the two slits are over each other. Slide one edge of the yellow disc under the edge of the blue disc so that half of the yellow disc is hidden under the blue disc.
- Put the nut on the shaft of the screw and tighten the nut to hold the discs in place.
- With your fingers on the shaft of the screw spin the disc like a top. What happens?

- Try increasing or decreasing the amount of yellow colour shown by sliding the yellow disc under or out from under the red disc. What happens?

- Try placing red, green, and blue discs on your top. Adjust the discs until you can spin the top to produce the colour grey.
- Try placing discs with the colours red, orange, yellow, green, blue, and violet on the top. Can you spin your top to produce the colour white?

- A hand drill may help you to control the speed of the top to produce the colours you want. Insert the shaft of the screw into the drill.

Light, Activity Card 5

The Eye

Locate a reference book that shows a good diagram of the eye. In the space below draw a diagram of the eye and name these parts:

— cornea	— retina	— optic nerve
— iris	— lens	— choroid
— pupil	— ciliary muscles	— sclera

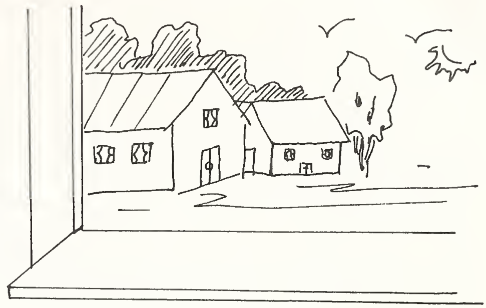
Reference Book Used: ____

Light, Worksheet 2

HOW A CONVEX LENS WORKS

You will need: a convex lens (magnifying glass)
a sheet of white paper
a room that can be darkened
a sunny day

- Darken the room except for one window.



- Hold the lens and the paper as in the picture so that light from the street can enter the lens.
- Begin by holding the lens against the paper but pointing out towards the street.
- Slowly move the lens away from the paper until a picture forms on the paper. You should see what is outside your window but the picture will be upside down.
- This lens behaves somewhat like the lens in each of your eyes. Your brain turns the picture right side up.

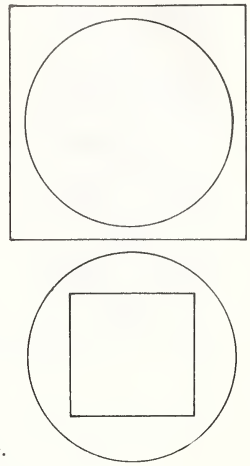
Light, Activity Card 6

MAKING COLOUR

- Use the cardboard disc and machine screw that you used with Activity Card 5.
- Cut out the disc above and place it on the shaft of the screw. Spin the top.
- Can you spin the top to form six rings?
- Try to adjust the speed at which you spin the top so that colours form on the rings.
- Spin the top in the opposite direction. What happens?

Light, Activity Card 7

OPTICAL ILLUSIONS



You will need: white paper
a compass
a ruler

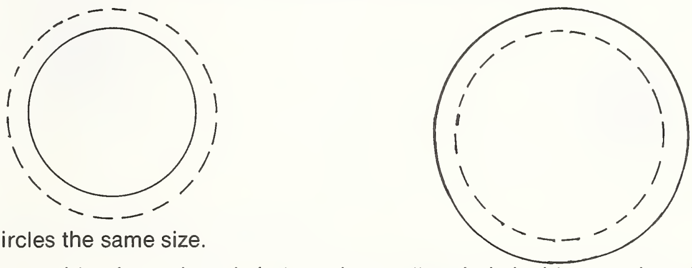
a stencil with circles
a triangle

- Follow the instructions that accompany each optical illusion to create your own optical illusion.
- Ask a partner to tell you which drawing looks larger.

(1)

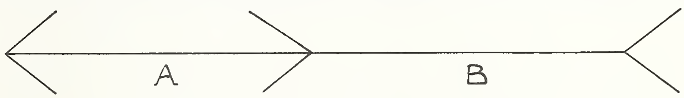
- Draw two circles exactly the same size.
- Outside of one circle draw a square. Inside the other circle draw a square.

(2)



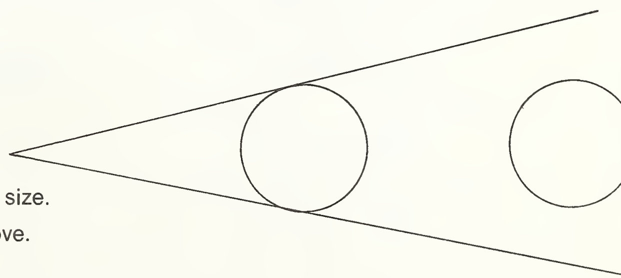
- Draw two dotted circles the same size.
- Draw a larger circle outside of one dotted circle and a smaller circle inside the other circle.

(3)



- Draw a line ten centimetres long.
- Lightly mark the middle of the line. Draw the rays of the arrow as illustrated above.

(4)



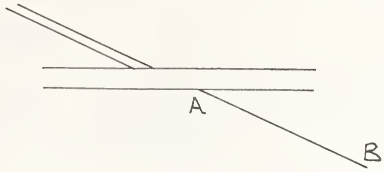
- Draw two small circles the same size.
- Draw two lines as illustrated above.

(5)

- To draw the squares illustrated above, you may wish to trace the corner points of each square and then use your ruler to connect the points.

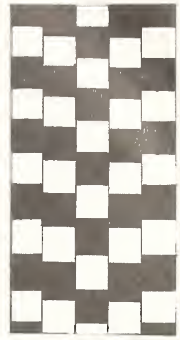
Light, Activity Card 8

(6)



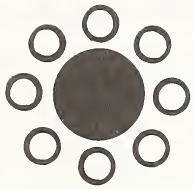
- Draw two horizontal and parallel lines one centimetre apart.
- Draw the short, slanted line which is on top. One millimetre away draw the second slanted line.

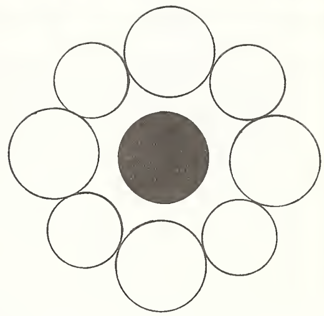
(7)



- Draw six parallel lines each 1 cm apart from the other and 12.5 cm long.
- Mark each side line with a dot every 5 mm to use as a guide for drawing the horizontal lines.
- It may be helpful to draw the 5 cm top and bottom lines first.

(8)



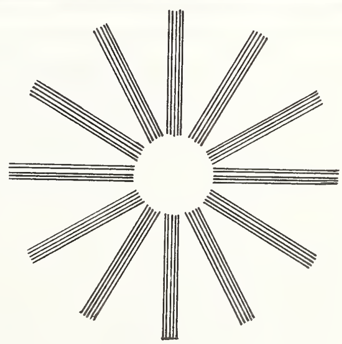


- Use your stencil to draw two circles of equal size.
- Colour them black.
- Around one circle make two types of larger circles. Around the other circle make a band of small circles with dark edges.

Activity Card 8 (continued)

TEST FOR

ASTIGMATISM

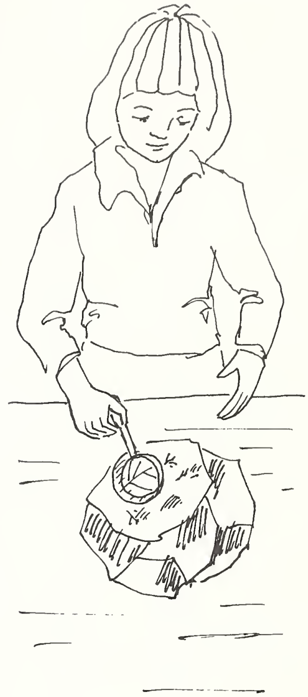


- You can test your eyes for astigmatism by using the chart above.
- Slowly turn this sheet of paper while you look at the chart.
- If one set of lines first looks sharper, than the other sets of lines, and then with more turning, becomes blurred while the other lines become sharp, you have astigmatism.

Light, Activity Card 9

FOSSIL:

A hardened remnant — or trace of animal or plant life — of a past geological age preserved in rock formation.



Large insects can become fossilized if they land and get stuck in soft mud or clay. Often the insect becomes completely buried in the mud which may later turn to rock. The insect eventually wastes away but leaves a natural print, or mold, of its body. If the rock becomes broken, an outline of the insect can be seen. Such prints or molds are known as fossils.

You may know of areas near your community where fossils have been found. Fossil hunting lets you discover what the environment was like thousands of years ago. That is long before books could record such information!

One of the most fascinating insect fossils is the "amber fossil". Trees, such as pines and spruces, have a sticky substance called *resin*. It can be found on the bark and trunks of trees. This sticky resin is like a trap for flies, ants and/or wasps. They get tangled in it. More resin flows over it and they become covered with a clear coating. Later this resin changes. It becomes hardened and is known as amber. These insects will be preserved for millions of years in this amber.

TRY MAKING AN AMBER FOSSIL!

You will need: a small jewellery box (about 4 cm^2) made of plastic or cardboard
a dead fly, wasp or ant
resin from spruce or cedar trees.

- Place a 3 mm layer of resin in your box. Set a dead fly in the resin.
- Completely cover the fly with a second layer of resin. Now set it aside and let it harden.

YOU NOW HAVE A FOSSIL!

Suppose that you are living on Planet Mars in 1 286 000 AD. You are a reporter whose spaceship has landed on Ancient Earth. In your travels on Ancient Earth you found this fossil. Report the discovery to those on Planet Mars and tell what you think the earth was like in ancient times. Compare it to the insects or its relatives of 1 286 000 AD!

A thought —
What kind of clothes do Martian reporters wear?

Another thought —
Why not bury this fossil in a time capsule for someone else to open in 100 years. Leave a message in your time capsule! Should you explain how you made it?

Soil Sürprises

Soil is soil, right? In this experiment you will find the answer to this question as well as a few surprises!

You will need: 6 small plastic bags and ties
6 gummed labels
soil samples

1 trowel
pen or pencil

- Collect three samples of soil from your property at home. These samples should be taken from three different areas of your property. For example: from your vegetable or flower garden, at the edge of your property and near the road. It does not matter if there are stones in your samples.
- Place a label on each bag to show where it was found. Bring the samples to school for analysis.
- Analyze each sample and describe what you found.

INFORMATION	BAG #1	BAG #2	BAG #3	BAG #4	BAG #5	BAG #6
WHERE IT WAS FOUND						
DESCRIPTION: COLOUR						
TEXTURE						
STRUCTURE						
BASIC, ACIDIC OF NEUTRAL						

Soil Sürprises

- Did all the samples appear similar? If not, why do you think they were not similar?

- Do you think that you would get similar samples in your neighbour's yard? Explain.

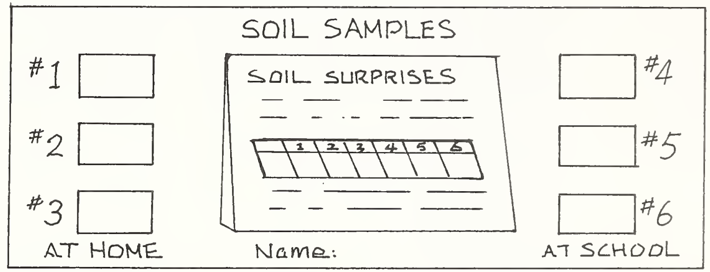
- Do you think that you would find similar samples on the school grounds?

- Collect three samples from three similar areas and analyze them. Record your findings on chart above.
- Was your prediction accurate?

- If there were differences — what might be the reasons for those differences?

- Mount your samples on a sheet of coloured paper.
  Attach these sheets beside the samples.

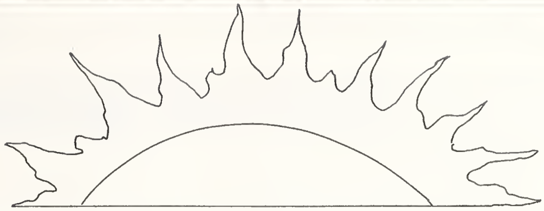
e.g.



- Would you agree that "soil is soil"? Why?

The Changing Land, Activity Card 7 (continued)

COAL
"Buried Sunshine"



Coal is a soft brown or black rock and is one of the most used rocks ever unearthed. It is sometimes called "buried sunshine". When we use coal as heat, we are taking advantage of stored energy from the sun. The energy was stored in plants that died and fell into swamps. The rest of the story you will discover later!

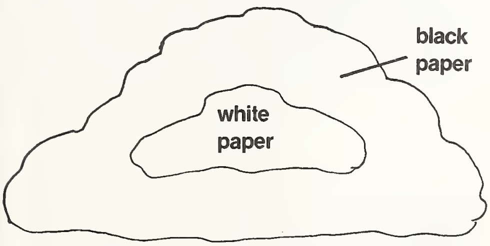
Most people will agree that a chunk of coal looks black and smooth. If you think so — you might be in for a surprise!

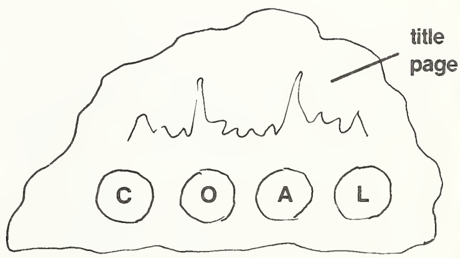
Place a small piece of coal under a microscope. What colour is it?

If you look closely, you might see the markings of a plant on it. These marks were made by plants that were present thousands of years ago in swamps.

Here's how you can find out about the story of coal. Make a booklet using black construction paper. Make a pattern of a very large piece of coal with black paper. Cut out your pattern. For each question, cut out a shape of coal.

Write your answers on irregularly shaped pieces of white paper and glue the white shapes on to the black coal shapes. Secure the pages together to make a booklet. On the title page you might wish to show flames with "white coals" under the flames. On each coal, write a letter of the word "coal".





How was coal formed?	How does peat play a role in the formation of coal?
Where is coal found in Canada? Show on a small map of Canada. Where does Canada ship her coal? Draw lines from source to importing country.	Do you think companies should be required to return the area to its natural state after strip-mining? Why?
There are 2 classes of coal. What are they? Which one is the hardest?	Stip-mining is one method of mining coal. Look at pictures showing this method. Do you think this is an advantageous method? Explain. What effect do you think strip-mining will have on the environment?
What products are made today from coal? Display one product made from coal.	

The Changing Land, Activity Card 8

GREEN BOOK (5)
Unit 6: Mapping the Earth
Pages 240-281

UNIT OVERVIEW

Concept Development

In the preceding levels of the program, the following concepts were introduced and developed:

The position of an object involves describing it with respect to some given properties or to other objects. Some words that can be used to describe position are: front, back, left, right, higher, lower, near and far.

Unit 6, "Mapping the Earth" is comprised of three chapters. Chapter one provides opportunities for examining a variety of maps and for discovering why maps are important. Various maps are presented and their special uses are explored in order to give students a broad perspective of how people use maps. Map symbols, colours, scales and grids are discussed in the second chapter. Chapter three emphasizes a variety of map uses. Various kinds of maps are presented to show how individuals and industry can use maps effectively. Another area discussed is the importance of maps to help plan the effective use of land areas when developing cities.

Process Development

Measuring, using numbers and *interpreting data* are skills that are essential in drawing or using maps. Students can *describe* a feature on a map in terms of its *qualities*, such as position, location and size. This observation, however, becomes much more significant and useful when it is expressed in *quantitative* terms, by applying a standard of measure to it.

For example, consider these three observations, based on the "Finding Out" on page 251:

The teacher's desk is large	*(qualitative)*
The teacher's desk is 110 cm by 80 cm	*(quantitative)*
The teacher's desk is larger than my student's desk.	*(quantitative)*

The first statement is open to interpretation because the observer's concept of "large" is not known. The second statement is more precise, and can be understood by other people, because a standard unit of measure has been used. The third statement, although not as precise, can be understood by people who have some experience with the size of a student's desk.

The precision of your students' observations will depend largely on their experience using measurements. As teachers, we should give students many opportunities to develop measurement skills.

In the "Finding Out" activities students first *interpret the data* shown on different kinds of maps (page 245), and *observe* and *compare* the symbols used on maps (page 248). They then draw a map of their classroom and *compare* their maps with those of other students (page 251). A *simulation* of an ore deposit is made in the "Finding Out" on page 262. The weather map in a newspaper is then studied and *interpreted* (page 265).

Related Units

Spaces and Places *Orange Book (1)*
Environment *Gold Book (2)*
Location, Motion and Force *Blue Book (3)*
Earth: Its Nature and Importance to You *Exploring Earth and Space (7)*

Materials and Advance Planning

The following list includes the materials that a student, or in some cases a group of students, will need to carry out the activities in this unit. In some cases, other materials may be substituted for those on the list.

Newspaper; news magazine; volume of an encyclopedia; Provincial road map; city map; metre stick; 2 drinking straws; rubber band; glue; bar magnet; needle; piece of cloth (1 m square); small metallic objects such as paper clips and nails; small nonmetallic objects such as wood blocks and pencil erasers

NOTE: Outline maps of the world and of Canada have been provided for use by students in this unit.

BACKGROUND INFORMATION

Chapter 1: Looking at maps, pages 242-245

No map can show everything. Usually, the features of a map are selected to show a particular idea or purpose. For example, a map can be used to show the location of surface features such as roads, rivers, and seacoasts. But a map can also be used to show underground features such as oil, natural gas, and coal deposits. Abstract features such as political boundaries and imaginary grid lines such as the equator may also be shown on a map.

Maps exist in many different types. Political maps emphasize cultural features, such as boundaries or the location of nations, states, countries, cities, and provinces. Physical maps stress natural features such as mountains, plains, rivers, lakes, and seacoasts. The typical classroom map often combines both political

and physical features. Such a map is often referred to as a general-purpose map.

Thematic maps are designed and used for specialized purposes. That is, thematic maps usually show only one or a few kinds of information, such as the climate, the landforms, the distribution of population, or the languages spoken in a given area.

Some maps are called relief maps. Relief maps give a three-dimensional perception of hills, mountains, valleys and other geographic areas.

Chapter 2: Reading maps, pages 246-256

Symbols make up the language of maps. Each type of map has its own set of symbols, and the number of symbols used in each type of map varies. For example, one kind of symbol is used on road maps to show paved roads and another kind is used to show unpaved roads. Likewise, a map usually displays different symbols for cities of different sizes.

Map symbols are classified in terms of their form. For example, point symbols are used to designate map features such as buildings, mountain peaks and towns. Line symbols include those of roads, rivers and political boundaries. Area symbols include colour and shading, or a design printed over an entire map's surface. These symbols are often used to distinguish the areas of nations, provinces, states, counties and political subdivisions.

If a map is used for the purpose of locating places, some type of grid (a series of equally spaced horizontal and vertical crossing lines) is needed. An example of such a grid is shown on page 252.

Some maps, such as those used by sailors, have a very precise grid on the map. The horizontal lines on such a grid are usually called longitudinal lines or meridians. The vertical lines on such a grid are usually called latitudinal lines or parallels. The intersections of meridians and parallels are then used to locate places on the earth.

Some maps such as a road map use a less-precise grid system. Vertical rows may be lettered "A," "B,'" "C," etc., and the horizontal rows may be numbered "1," "2," "3," etc. An area within which the desired place is located may then be located on such a map by noting where a particular letter line intersects with a particular number line.

A map scale is a mathematical relationship, or a ratio, between the size of features on the earth and the size of corresponding features on the map. The simplest scale is the graphic scale. It is usually a ruled line or a bar that is marked off in kilometres. However, some maps use a verbal scale that uses words such as "20 km to 1 cm".

A third kind of map scale is referred to as a fractional scale, which gives the degree of reduction. This scale is written 1/1000, for example, or 1:1000. The 1 refers to the units of measurement on the map and the 1000 to the same units of measurement on the earth's surface. It would read "one to one thousand".

Although there are many map scales, there is no ideal map scale. Usually a scale results in a compromise between two conflicting goals, the representation of as much detail as possible, and the maximum area to be covered.

Chapter 3: Using maps, pages 257-277

Maps may be used in many different ways and for many different purposes. People can use maps to tell where other people live and how many people live in a certain area. Such a map is called a population map. Some maps can show various patterns in cities. For example, a large-scale map of a small area of a city may show street patterns, railroad systems, bridges, and buildings.

Political boundaries between countries, states, or provinces are often expressed by using political maps. Physical features such as elevation, rivers, and lakes and the importance of these features to the existence of people can also be shown by means of a map.

Many maps are made to show routes of travel and transportation. Some are made to show territorial rights of animals. Others are used to show migration routes.

Information about species and habitats of plants and animals can be mapped. Maps made from information collected by satellites orbiting the earth can show where certain mineral deposits lie in the earth's crust or where insect infestations are affecting forests and land crops. Weather maps contain information on temperatures, precipitation and frontal conditions throughout the world.

TEACHING STRATEGIES

The purpose of the following activities and teaching strategies is to provide you, the teacher, with a wide variety of suggestions that can be used, together with the material presented in the textbook, to help develop the processes and concepts of this unit.

Chapter 1: Looking at maps, pages 242-245

— Pages 241-244 can be read and discussed.

— It would be useful to stress the idea that specific information is important when giving written or verbal directions to locate a place. There are a number of exercises below that will develop this skill. Each pupil could write directions for a friend to follow. The friend could actually follow these directions or, check them with a map.

(a) Give directions to reach a specific area on the school grounds using the instructions "left", "right", or "straight ahead", etc.

(b) Give directions from the school to their own house.

(c) Give directions to reach a specific place in your community starting at the school and proceeding to a theatre, fairgrounds, post office, service station, supermarket, arena, recreation centre or bus depot. (Students will require a community map.)

(d) Give directions for a trip across Canada that includes main cities and a few towns. This time, students could include highway numbers plus other directions (e.g. N, NE, NW, S, SW, SE, E, W.) They could also plot this trip on a map of Canada.

(e) Give directions, using a provincial map, for a vacation trip to a well-known city, lake or provincial campground in the province. Students should be reminded to make reference to highways, secondary roads, ferries, etc.

— The "Finding Out" on page 245 has a worksheet available in the activity book (page 43).
— Plan an itinerary of an air trip from the closest airport to a destination off the North American continent (e.g. Medicine Hat, Alberta to Tokyo, Japan). A world map could be marked to show the major cities en route. Maps from commercial airline brochures can be used as a resource.
— Obtain route maps from two commercial airlines that have flights using the same departure and destination points — e.g. depart Vancouver, arrive Honolulu. Students can compare the two routes and their findings can be discussed. You could ask: Do the two airlines use the same air route? Why or why not?
— "Activity Card 1, Free Ticket" has children consider the kinds of agriculture in various parts of the world. This is an extension of the suggested activity on page 244.

Chapter 2: Reading maps, pages 246-256

— Read and discuss pages 246-247, Symbols.
— A worksheet is available for the "Finding Out" on page 248 in the activity book (page 44).
— "Worksheet 1, Traffic Jam" and a provincial road map can be placed in the science centre.
— Early maps used by explorers can be compared to today's maps of the same area. You could ask the following questions: What information is given on each map? Why does the modern map have more information? How do you think the early explorers managed with so little information?
— The more able students may wish to design a map for a blind person. Please see "Activity Card 2, The Blind Can Read Maps Too." For this activity the students will need a Braille card, stickers or other objects to represent buildings and streets, a casette tape and tape recorder. The completed maps and tapes can be placed in a science centre or in the library. Other students can experience this trip by using the map and the tape.
— Pages 248-251, Colours and Scales, can be read and discussed.
— Students can make contour maps using pieces of corrugated cardboard. They should display a legend to accompany the map. Pupils can use an encyclopedia or other library books to learn how to make a contour map showing land elevations.
— "Activity Card 3, You First!" suggests that pupils can make their own map using a colour code to show ski areas and national parks in their province.
— A worksheet for the "Finding Out" on page 251, is available in the activity book (page 45).
— Students could compare two or three provincial maps which show similar information but are drawn to different scales. They will likely observe that although the maps include similar information, the scale is different on each and the maps may be of different sizes.
— Pupils can make a map for a close friend to show their secret hideout.
— Students enjoy designing their dream house showing floor plans and landscaping. They could put this information into booklet form using an index and present their dream house to the class.
— To extend the "Finding Out" on page 251, students can map different rooms in their home using a scale to show the size of the rooms and the location of large pieces of furniture. This information can be mounted on a larger sheet of paper cut in the shape of their home.
— You may wish children to be aware that although maps often state the distance between two cities, the length of a river is not given on a map. You could ask: How could you measure the length of a winding river on a map? (Place string along the river, then measure the length of the string. Use the scale to determine the length of river.)
— A set of math problems could be made to accompany a map. These cards can be placed in a math centre.

(1) If 1 cm = 10 km, calculate the distance between these places:
(a) Toronto to Hamilton (b) Edmonton to Calgary OR (c) Calgary to Regina.

(2) If 1 cm = 25.5 km, determine the shortest distance between ____________ and ____________.
Record the route that you used.

— Pages 252-256, Grids, can be read and discussed.
— Students may like to play the game "On Target". This game gives practice in using a grid to locate places or streets. You will need 3 maps exactly the same (road or street maps). The class is divided into 3 groups and these groups should be balanced in ability. Each group is assigned a name and given the following:

Group 1: The Cartographers (receive a bongo drum and a map)
Group 2: The Planners (receive a tambourine and a map)
Group 3: The Surveyors (receive a maraca and a map)

The Teacher calls out a location (e.g. C3). Students in each group try to locate the city, town or street and when they find it, they point to it on the map. Then they shake their instrument. (Each team must find the location.) The team that locates it first gets 50

points, the next team gets 30 points and the last team gets 10 points. Record the scores on the blackboard.

— The above game, "On Target", also can be used to locate cities on a world map or in an atlas using parallels (latitude) and meridians (longitude).

Chapter 3: Using maps, pages 257-277

— Pages 257 to 259, Using maps to study migration routes, can be read and discussed.

— Migration: A discussion could centre around the idea that Canada has a rich cultural mosaic of many ethnic groups. These ethnic groups have migrated to Canada from their homeland for many reasons: (a) to escape war or religious persecution (b) to improve or change some aspects of their way of life (c) because they have used up their homeland's natural resources and seek new ones.
The ancestors of most students will have migrated to Canada from other countries.

Students can ask relatives to supply them with information as requested on "Activity Card 4, Tracing My Ancestors." Their ancestors' departure and arrival points can be shown on a world map posted on the bulletin board. Each student's information form can be placed below the map for others to read.

The teacher should prepare a very large chart using the headings given here. The students can complete the chart using their information. The data can be analyzed in a large group situation.

PUPIL # REASON FOR EMIGRATION DEPARTURE POINT	ARRIVAL POINT OCCUPATIONS IN HOMELAND IN CANADA

What is the most common reason for migration?
What is the most common departure point?
What is the most common arrival point in Canada?
Did most the the occupations remain the same or were they changed when they moved to Canada?
What general statement can we make from our observations of the data?

— Students might wish to investigate the reasons why the Chinese, Japanese, Italians, Hutterites and other ethnic groups immigrated to Canada. Their information can be presented to the class. If they have pictures, slides or other pictorial material it would add interest to their project.

— If your school is located near a national park, you could invite a park naturalist to visit the class to discuss (1) the migration routes of animals (2) how they track a species' migratory habits and (3) the types of equipment used to collect this information. Hopefully they will bring monitoring devices to show the students.

— Personnel from the Canadian Wildlife Service could explain their role to your class and convey information about the migratory habits of birds and animals of your area.

— You could present this situation to the class and generate discussion:

The same bear has appeared 3 times in your neighbourhood in the last 2 months. It upsets garbage cans and often stalks pets. Each time the bear has been removed by the Wildlife Service personnel, taken to a remote area and released.

However the bear has returned for the fourth time. Neighbours are concerned for the safety of children and pets. Should this bear be removed again or destroyed?

This situation also could be used in the form of a debate using the statement: "Be it resolved that .... Any bear which returns more than twice to the same location should be destroyed".

— Pages 260 to 264, To help find minerals, can be read and discussed.

— You could take a field trip to a local mine. Students may wish to prepare questions for the mine personnel. (e.g. How did you discover this deposit? Do you know how large the deposit is? Is this a "producing" mine? Is this mine listed on the Stock Exchange? Where do you ship this mineral? Do you see this mineral being used for other purposes in the future? If so, how?

— It would be interesting for students to graph the progress of some of the mines in your province that are listed on the Stock Exchange. The locations of these mines could also be marked on a map; in the legend they could list the commodity and use a colour code system.

— Students could look at pictures related to open-pit mining. Then they could discuss the advantages and disadvantages of open-pit mining, with reference to: (a) the cost (b) the results on the environment and (c) the esthetic aspect. You could close the session by asking students: Do you think that companies should be requested to re-landscape the area?

— Students would work in pairs and choose one of the following topics to research:

diamonds	coal
oil	uranium
gold	salt
copper	tin
potash	nickel
natural gas	mercury
iron	cobalt

Their information could be organized in a booklet format and include:
— Index
— A world map to show the locations of this resource
— The use of this product through the ages
— Methods used to obtain the raw product

- —Uses for the finished product
- —Possible new uses in the future
- —Bibliography
- —Pictures of this product being mined and articles made of this product.

—Pages 265-269 can be read and discussed.

—A worksheet for the "Finding Out" is available in the activity book (page 48).

—You could either have a representative from a weather control office visit the classroom or you could visit a weather station if one is near your school. Maps and instruments used in weather forecasting could be shown to the class. Perhaps the students would like to make a weather station on the school grounds and give a daily weather forecast over the public address system or just to their class.

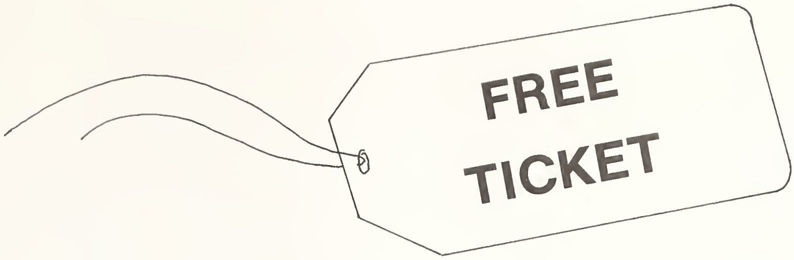
—Students would listen to the radio or television weather forecast, read the forecast in the newspaper and then present this information to the class.

—Pages 270-278, To help plan cities, can be read and discussed.

—Children can suppose that all the land on earth has been used. Now we must look at other alternatives in city planning (for example: under the sea and/or underground). They could work in pairs and make a diorama showing suitable kinds of living accommodations and vehicles for transportation. These dioramas can be displayed in the hall for all students to examine.

—Models of futuristic cities could be created. Their city could be operated by solar energy. Have the students think about shape and texture when designing their cities and landscaping. The questions on page 275 might assist them in their planning.

—"Activity Card 5, My Very own Island!", can be used as a final activity for this unit.



It is your task to visit various areas of the world and study the agriculture of each area.

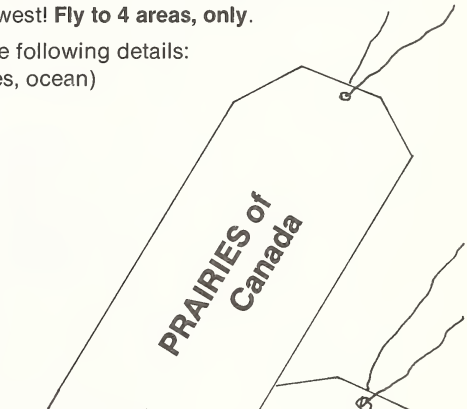
Visit these countries flying from "book to book" in your library. You must admit — it's a very cheap form of travel! Try to make a circle tour of these countries, starting with the country that is closest to you. You may head north, east, south or west! **Fly to 4 areas, only**.

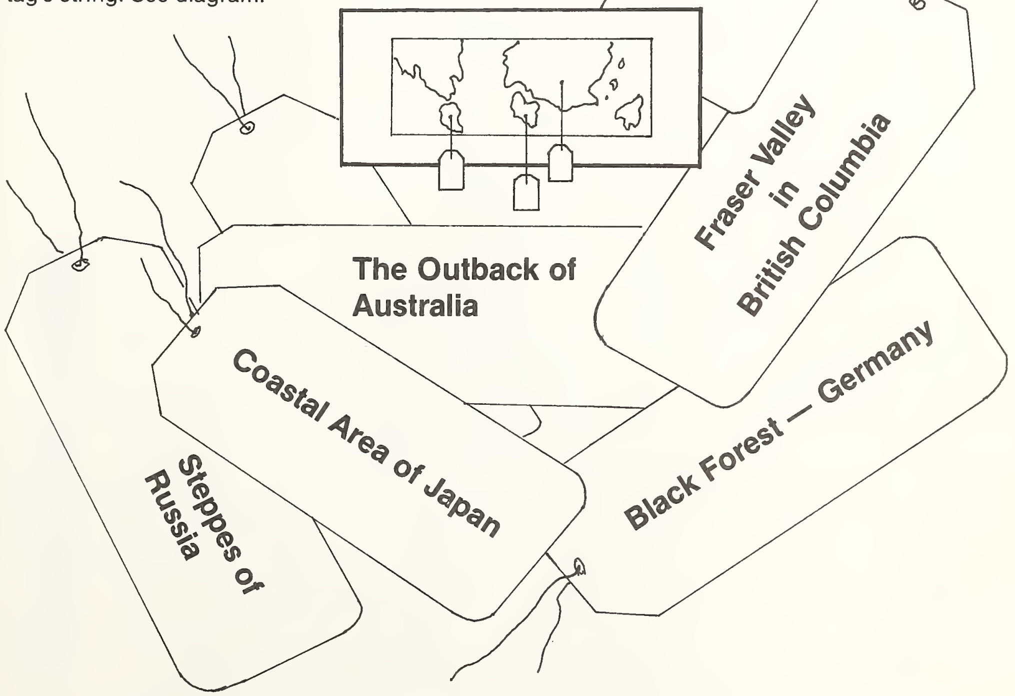
Tell a story about each of these countries. Cover the following details:

The country's
- water resources (rivers, streams, lakes, ocean)
- climate
- soils
- types of agriculture

You can print the information on travel tags — place the country's name on the front of the tag and a small picture representative of the area. The information can be printed on the back of the tag. Mark the areas on a world map and mount your map on a large piece of coloured cardboard.

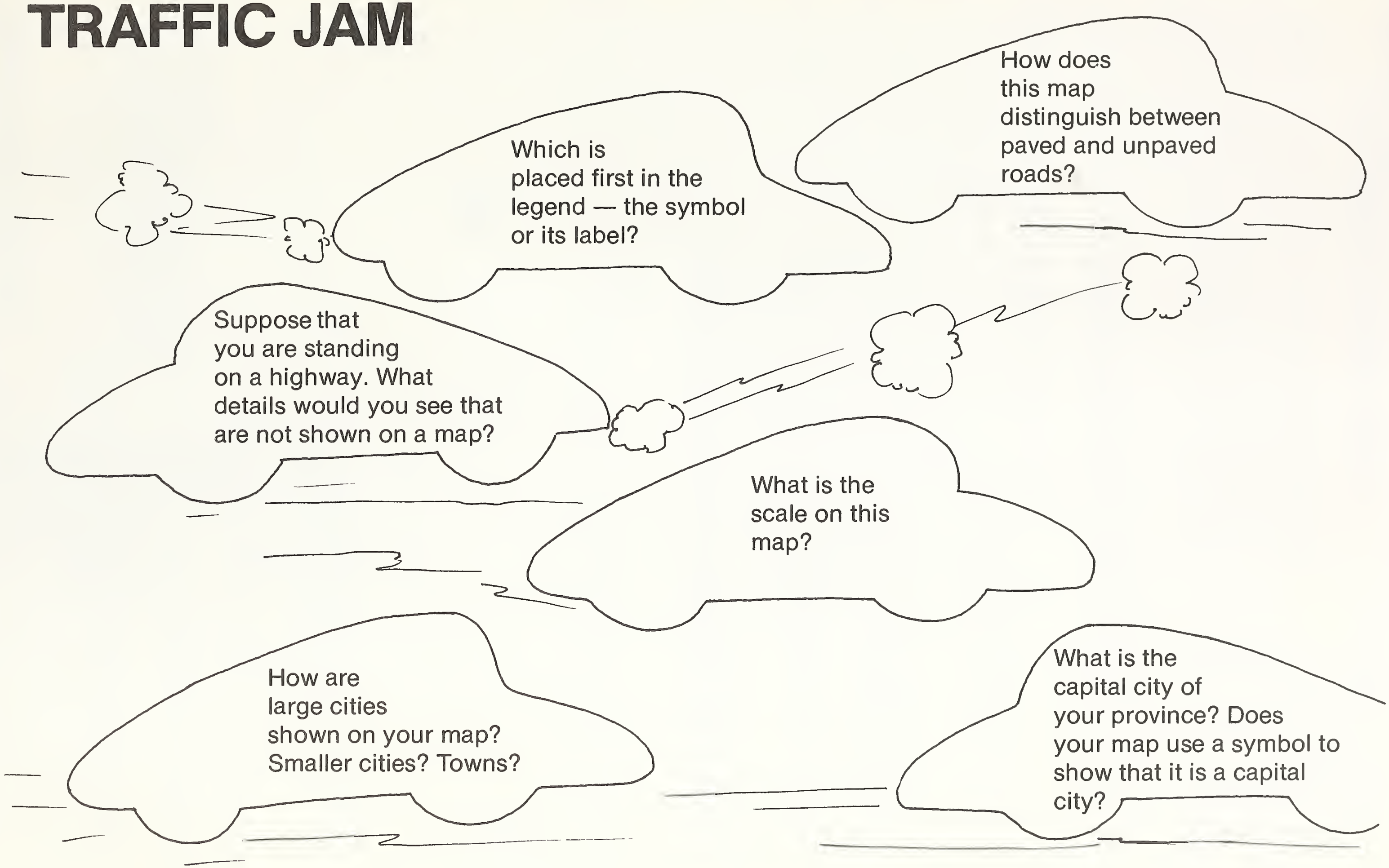
Puncture a small hole in your map and attach the tag's string. See diagram.





Mapping the Earth, Activity Card 1

TRAFFIC JAM



Which is placed first in the legend — the symbol or its label?
How does this map distinguish between paved and unpaved roads?
Suppose that you are standing on a highway. What details would you see that are not shown on a map?
What is the scale on this map?
How are large cities shown on your map? Smaller cities? Towns?
What is the capital city of your province? Does your map use a symbol to show that it is a capital city?

THE BLIND CAN READ MAPS TOO!

Mr. James, a blind person, has moved recently to your community. He is a young person and wants to be independent. He would like to get out more in the community and take part in community activities. He enjoys going to the theatre and the recreation centre. However he needs a map to locate these places. Also, he thinks that a cassette tape with directions on it would also help him.

He has hired you to design a map and a tape to guide him to each of these facilities. Since this task requires you to do two maps and two tapes, you might wish to have an assistant help you!

Here are a few questions to guide you in your planning:

1. What size of map will you use?
2. What symbols in the legend will you use to represent his home, the streets, the theatre and the recreation centre?
3. How will you show the cross streets on your map?
4. Are the theatre and the recreation centre located in the same area or some other area?
5. Does your tape use specific directions? Close your eyes, turn on the tape and follow your verbal directions on the map. Did you reach your destination?
6. What other maps might he need? A map to direct him to the record store, the post office, a bank or a shopping mall might be useful. Design one of these maps.
7. Do you know a blind person who could "test" your maps?
8. Could you make the tapes more interesting by adding "tour guide" details about the places he will pass on his way to his destination? Be sure the extra details don't overpower the instructions on the tape.

Mapping the Earth, Activity Card 2

You first!

You will need:

— an outline map of your province
— a map showing national parks
— brochures about skiing facilities

Show the national parks and the popular skiing areas in your province. Use colour to convey each type of information.

Study your map.

- Are all the skiing facilities in one area or many areas?
- Why are these skiing facilities placed in these particular areas?
- Are any skiing facilities located in any of the national parks?
- Who would own and operate these skiing facilities?
- Which facility has the longest ski run?

Mapping the Earth, Activity Card 3

TRACING MY ANCESTOR'S LIFE

Arrange to have a chat with some grandparents or other relatives that have immigrated to Canada. Explain to them that you would like to learn about their trip and collect a few facts for a science project about the migration of people. They would also be interested to know that you will be marking their departure and arrival points on a map at school.

When everyone has marked the map, your class will be analyzing the information to find:

— the most common reason for migration
— the most common departure point
— the most common arrival point in Canada
— if the occupations remained the same or were changed when they arrived in Canada.

Complete the form below at some point in your conversation.

Your name ________________ Flag number ________________

My ancestors emigrated from ________________, ________________

to ________________________, ________________________.

They emigrated in the year ____________.

Reason for Emigration: ____

____

Occupation in homeland ____

Occupation in Canada ____

When you have obtained the above information you can:

- Obtain a flag pin and a regular pin. Attach the flag pin to the map where they departed and place the other pin on the place where they arrived in Canada.
- Connect the pins with string.
- Your teacher has prepared a chart. Take the above form over to the chart and fill in the data.
- Cut out this form neatly and staple it to the bulletin board underneath the map.

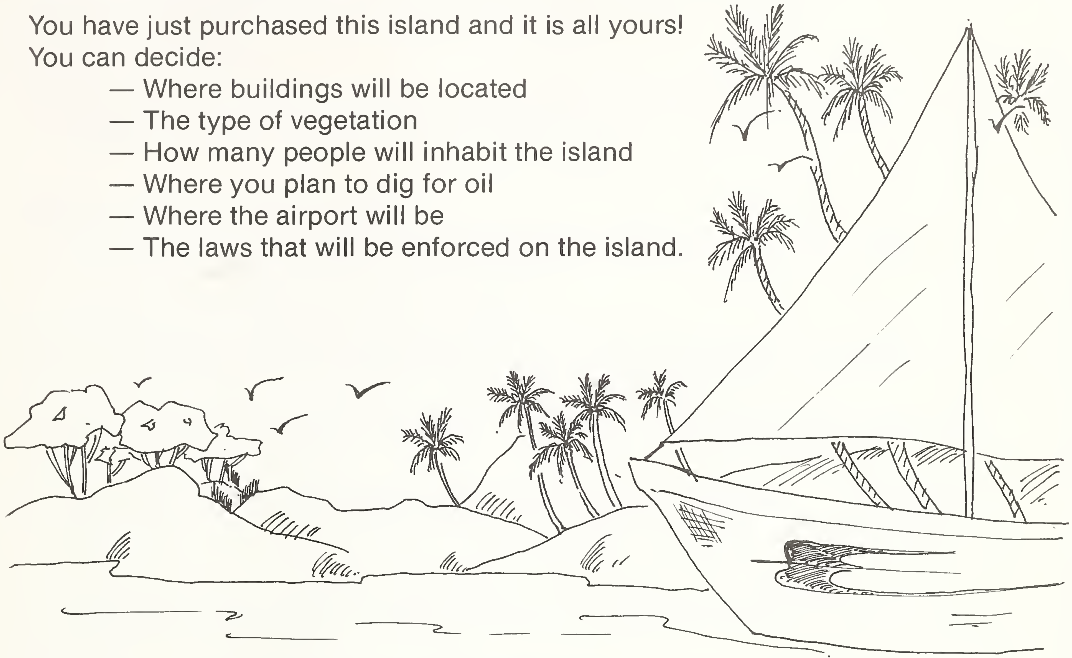
Mapping the Earth, Activity Card 4

MY VERY OWN ISLAND!

Have you ever imagined yourself living on your very own island?

You have just purchased this island and it is all yours!
You can decide:

— Where buildings will be located
— The type of vegetation
— How many people will inhabit the island
— Where you plan to dig for oil
— Where the airport will be
— The laws that will be enforced on the island.



Create a map on a large piece of cardboard. Colour it and make it extremely inviting, because tourists may want to visit your island!

****

A well-known Canadian television interviewer has asked your permission to interview you about your island. He has sent you a list of questions that he would like to ask. This gives you a bit of time to think of some responses. Don't forget that this interview will be broadcast across Canada — it could make some tourist dollars for you. The interviewer happens to be a good friend of yours!

Mapping the Earth, Activity Card 5

My Very Own Island

INTERVIEWER'S SCRIPT

Make up a short introduction to tell your viewers
(a) Where you are
(b) Why you are there
(c) Give the name of person being interviewed and his role on the island (e.g. creator of island, mayor, owner or ??)

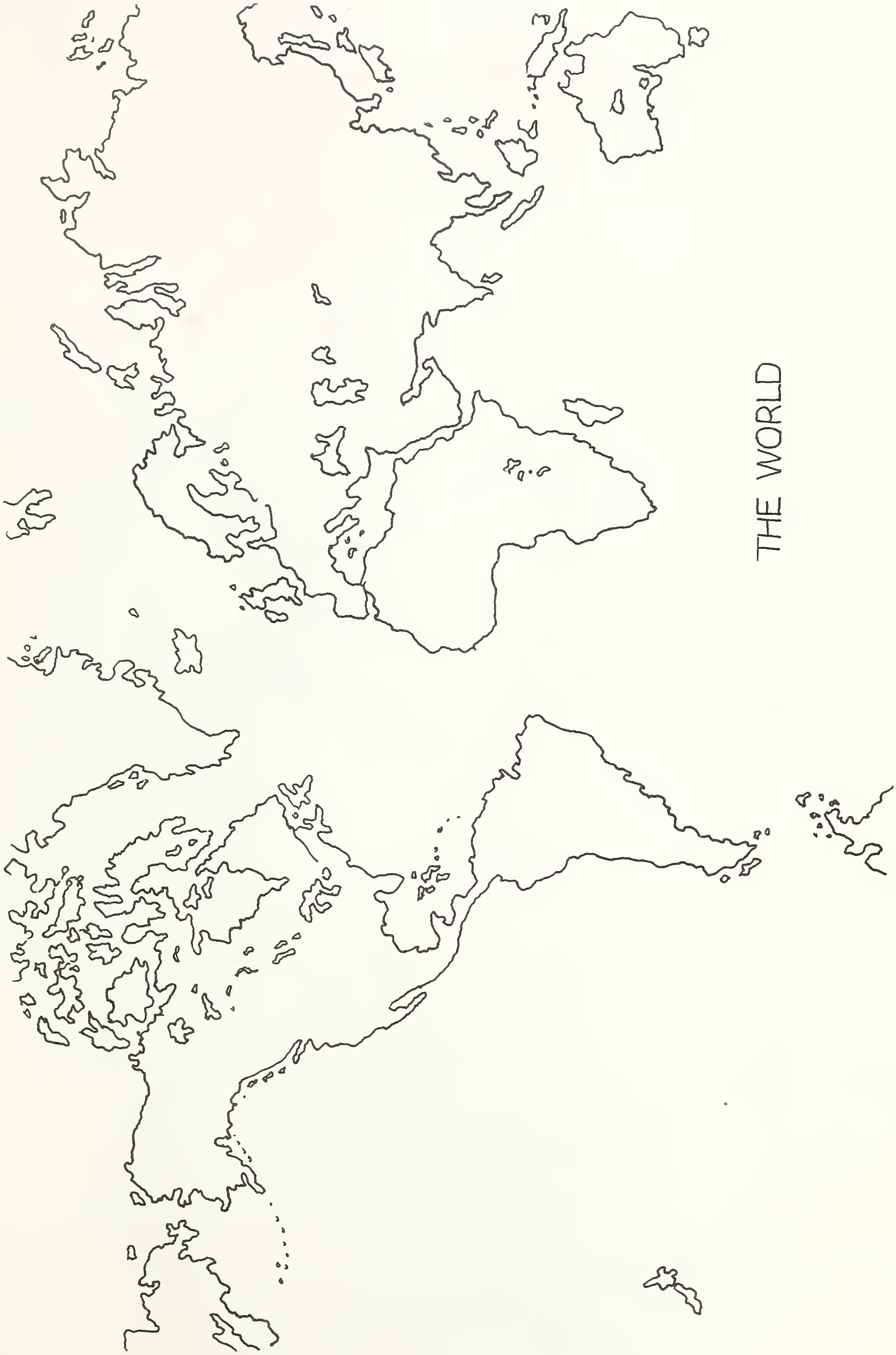
QUESTIONS TO ASK OWNER:

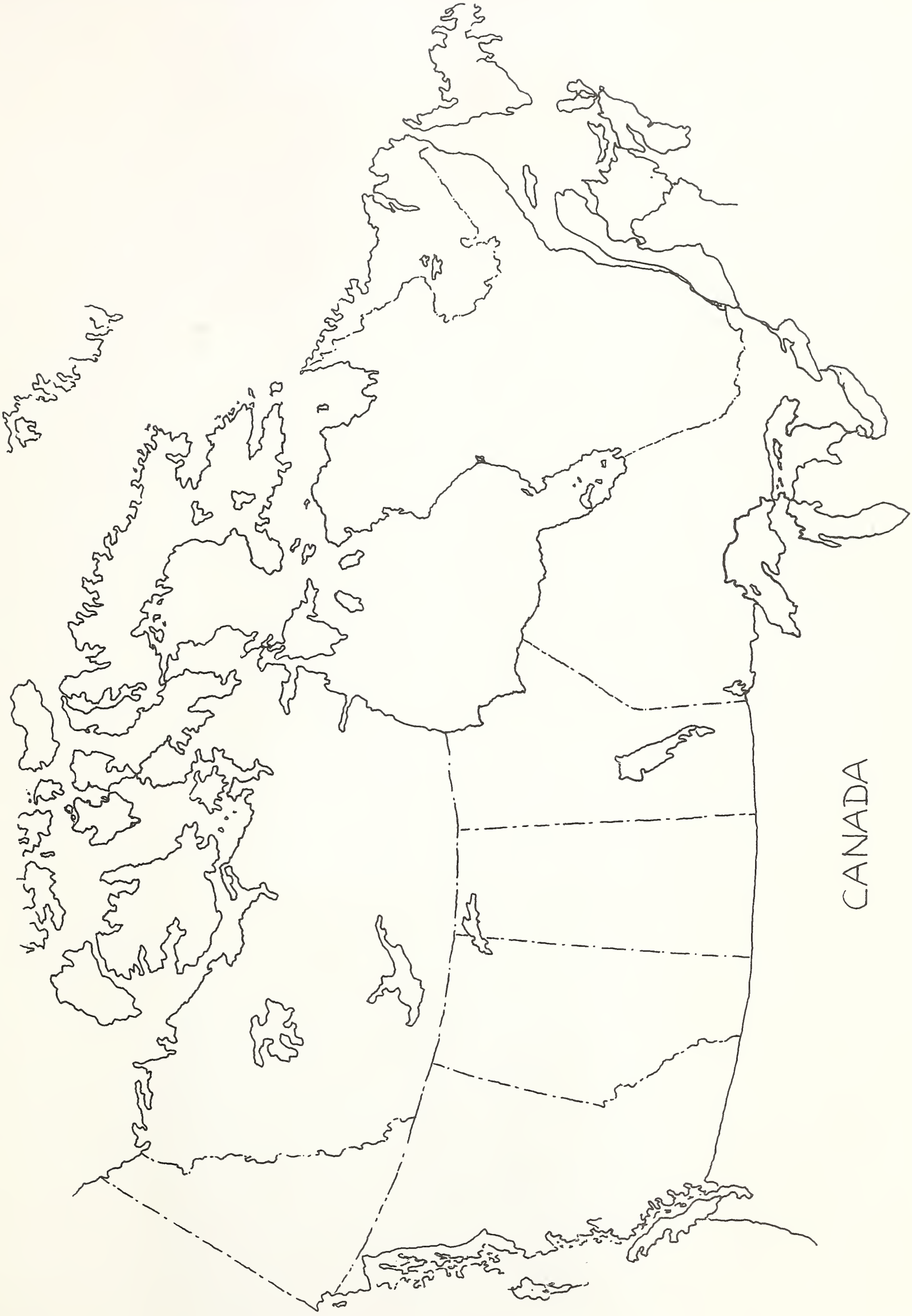
- Reports are that your island has had quite an influx of tourists this year. What is it that brings them to your island?
- How does this help the public's purse?
- We understand that oil deposits have been discovered here and that big companies want to move here. How do you feel about that?
- We understand that you are using a new method to obtain water. Would you like to tell us about that?
- The weather pattern has changed in recent years in this area — from hot to cold. Plants and animals will soon be affected. Do you see this creating a problem?
- Tidal waves frequently have been reported in this area. What procedure do you follow if they hit?
- What kind of laws operate on this island?
- I understand that you are concerned about the air pollution from jet take-offs and arrivals. What actions do you plan, to control this pollution?

Close off your interview by making some positive comment about the island. Then conclude by saying:

"This is ______________________ reporting for ______________________ News in ________________.
(island)

Mapping the Earth, Activity Card 5 (continued)


THE WORLD


CANADA

The Exploring Science Program